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LARYNGOSCOPE.

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OFFICE PROCEDURE IN HEARING EVALUATION. A PRACTICAL APPROACH.*

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In the past 20 years and particularly during the past seven years so many hearing tests have been suggested and conducted, and so much research on hearing tests has been carried out, that the otologist may well feel confused. He may ask, "Which of these tests is the most reliable?" If in private practice, he may inquire, "Which test is not only reliable but also practical from the standpoint of equipment and time consumption?"

The clinical investigation presented in this paper was undertaken, primarily, for the purpose of determining the essential tests and minimum physical equipment required in private practice for a reliable evaluation of hearing loss. Admittedly, it is with considerable trepidation that the writer approaches this exhaustive subject, to which valuable contributions have been made by many eminent men, including Carhart, Davis, Fowler, Guild, Hoople, Mueller, Reger, Silverman, Walsh and Westlake. It may be that some phases of the test proposed will appear somewhat unscientific, but it should be borne in mind that a concerted effort has been made to arrive at a practical method of testing and evaluation.

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HISTORICAL REVIEW OF TESTS OF HEARING.

The first method used to measure auditive acuity was the human voice, but this method presented limitations because of variations inherent in the voice and speech, and because of the lack of an accurate system of measurement.

Early examiners turned to the use of the watch, the coin click and the tuning fork as practical mechanical devices for producing uniform sounds. The development of tests with tuning forks is particularly interesting, and will be described further on in this paper. All these instruments proved to have drawbacks due to variability. As stated by Hays, "No two instruments, no two tuning forks, no two watches will ever be alike, so that there is no value in comparing the hearing of an individual patient when a test is taken with two different instruments, and by two different men with different watches and tuning forks."*

The next instrument used to measure auditive acuity was the so-called acoumeter, which was first suggested by Wolken.[37] This was a simple device with sound produced by hitting an oaken hammer against a fir plaque at a determined angle. The patient closed his eyes and raised his finger each time he heard the sound. From 1864 several different types of acoumeters were devised. Conta,[6] attempting to estimate how many seconds a sound is heard, devised an instrument making use of a tuning fork as the source of sound. The tuning fork was vibrated by hitting it on the knee, and then its stem was inserted into a rubber tube, which was introduced into the ear. Magnus[25] in his instrument used a tuning fork which was fixed to a table and struck with an ivory ball, always with equal force. At the end of the tuning fork was placed a kind of acoustic horn, in which the sound waves were gathered and projected into a tube. Kessel[20] fabricated an apparatus with the mechanism of a music box. In Politzer's[28] instrument a cylinder encased in rubber was struck with a small hammer.

In 1878, Hartmann[13] described an instrument making use of the recently invented telephone receiver, the tuning fork

*Hays, H.: An Improved Audiometer. The Laryngoscope, 23:866, 1913.

and controlled electric current. This apparatus, however, was too intricate to be generally accepted. At about the same time, Hughes[17] presented an instrument to the Royal Society which consisted of: *1.* the new induction currents balance; *2.* microphone, with a clock as a source of sound; *3.* electric sonometer, or absolute sound measurer, and *4.* a receiving telephone and three elements of Daniell's battery.* It was in the work of these two men that the modern audiometer with sound produced electrically had its genesis. Shortly after Hughes introduced his instrument, Richardson[30] proposed its use for measuring the effect of disease, treatment and atmospheric pressure on the acuity of hearing.

The instruments devised by Hartmann and Hughes received recognition both in Americe and Europe, and in the years following their introduction, literature contains many descriptions of audiometers with variations and modifications. Different sources of sound were used, and attempts made to overcome the limitations of the earlier devices, due to their cumbersomeness, complicated construction and restricted range of sound production. Instruments were described by Körting,[21] in 1879; by Lacharrière[22] and by Boudet de Paris,[3] in 1882; by Urbantschitsch,[34] in 1884; by Cozzolino,[7] in 1885; and by Cheval,[5] in 1890. In 1880, Maillard[26] replaced the clock and microphone used in Hughes' instrument by a small Gaiffe battery equipped with an interrupter which produced the sound. Variations suggested by Jacobson,[19] in 1885, consisted of a second induction coil for controlling the volume of sound produced, and the use of two rubber tubes for transmission of the sound to the ears. An audiometer was described by Henry,[15] in 1896. Bezold[1] devised a continuous tone series of tuning forks to provide a wider range of sound. In 1904, Reid[29] described another audiometer. An improvement in the audiometer was suggested by Faught,[10] in 1911, which permitted measuring the acuity of hearing in either ear to the exclusion of the other, and the instrument was so controlled that the patient was unable to know either the intensity of sound or which ear was being tested. Hays,[14] in 1913, devised

*Hughes, D. E.: Nature, 20:78, 1879.

an audiometer using the watch and tuning fork, whereby the hearing distance of a patient would vary less than 0.5 cm.

In 1914, Stefanini[33] made an important contribution to the development of the audiometer in introducing an electric generator capable of a wider range of frequencies. It remained for Bunch in collaboration with Dean,[9] in 1919, to apply this type of generator to the audiometer. The new pitch range audiometer made it possible to produce tones between 30 and 10,000 cps. in a continuous sweep through the entire range of pitch and intensity. It produced tone relatively pure; it provided for varying extremes of intensity; and it permitted accurate measurement both as to pitch and intensity of tones. The apparatus could be operated quickly and easily and had practical application for the measurement of conventional hearing tests. Although the instrument was applied to clinical otology, it was not available commercially.

The next important step in the development of the modern audiometer was the utilization of the vacuum tube by Minton and Wilson[27] and by Guttman,[12] in the year 1921. The following year, as the result of research by the American Telephone and Telegraph Co., the Bell Telephone Co. and the Western Electric Co., the Western Electric 1-A Audiometer utilizing pure tones as the stimulus was produced. It was presented to otologists by Fowler and Wegel,[11] in 1922. Because of the cost of the instrument, it was not generally adopted, and the Western Electric Co. went on to devise the less expensive audiometer, the 2-A.

Since 1922, many improved models of audiometers have been developed and placed on the market. Rapid strides have been made particularly since 1945, and there are now available several audiometers that fulfill all the requirements for the evaluation of hearing loss.

The utilization of recorded words on a wax cyclinder, in place of pure tones as the source of sound, was first advocated by W. S. Bryant,[4] in 1904. The test consisted of selected monosyllables recorded at a constant level. The phonograph was enclosed in a soundproof box from which the acoustic

signals were conveyed to the listener's ear by a tube. This tube was equipped with a valve which, by regulating the diameter of the tube, controlled the intensity of the signal. Thus it was possible to express hearing loss in terms of different degrees of valve openings at the threshold of normal and defective ears. Due, probably, to the relative crudeness of the phonographic equipment of that day, the test was not widely used.

In 1926, the Bell Telephone Co., in cooperation with the American Federation of Organizations of the Hard of Hearing, developed the first widely used recorded auditory test for determination of hearing loss with speech. This test consisted of spoken digits and was known as 4-A; today it is known as 4-C. Following research at the Psycho-Acoustic Laboratory of Harvard University, recorded auditory tests were developed for measuring hearing loss with speech. With but slight modifications, these tests are accepted today as the most reliable recorded auditory tests.

Tuning Fork Tests. In the sixteenth century, Ingrassia[18] called attention to the fact that it was possible to hear a vibrating tuning fork when it was held against the teeth. In this fashion the phenomenon of bone conduction was observed. It was not until about three centuries later that the classical tuning fork tests were developed which formed the basis of differential diagnosis of conductive and perceptive deafness.

The first of these tests was described by Weber,[35] in 1834, as follows: "If both ears are closed by the hands, one's own voice is better heard than with open ears. If one ear is closed, one's own voice is better heard by the closed ear. If a tuning fork is pressed against the teeth and the mouth closed as firmly as possible and the ears are closed by the fingers, the tuning fork is better heard than with open ears; however, when the meatus of one ear is closed and the other one is open, the sound is stronger heard in the closed than in the open one." Weber also noted that a deaf person may hear a tuning fork pressed against the skull better in the ear with the greater loss of hearing.

Ten years later, Bonnafont[2] applied Weber's test clinically for diagnostic purposes. Using a series of tuning forks with a wider range of sound than that of the ordinary tuning fork, he sought to diagnose accurately certain types of deafness and to classify those which were incurable with medication.

The second test was suggested by Rinne,[31] in 1855, and was based on the practice of holding the tuning fork first against the upper incisors and then near the external auditory meatus, making it possible to compare air and bone conduction.

In 1885, Schwabach[32] described a bone conduction test in which a tuning fork was placed against the vertex. To differentiate between conductive and perceptive deafness, he considered it of importance to determine how long a deaf person heard the tuning fork, and compare the time with the time it was heard by a person with normal hearing.

Clinical application of bone conduction tests was made by Lucae[24] and by Bezold.[1] The latter made use of a series of clamped tuning forks, which gave a greater uniformity in intensity of tone than other forms of apparatus in use. In slight degrees of ankylosis of the stapes in unilateral sclerosis, he noted that Rinne's test showed a shortened positive or negative result, even in the opposite ear, despite the fact that the hearing for speech in this side was normal or nearly so. In exudative processes and swollen lesions of the middle ear, Rinne's test was found to be positive, although shortened, despite a relatively high degree of deafness for the voice. When one ear was very deaf and the other about normal, there was a decidedly positive result with Rinne's test. After traumatic ruptures of the tympanic membrane, Rinne's test was positive, but shortened.

Quantitative tuning fork tests were developed so that the acuity of hearing could be determined over a wide range. Politzer[28] determined the frequency of tuning forks from 32 d.v. to 4,096 d.v., and it is interesting to note that many manufacturers have recognized these numerical values.

INVESTIGATIONS.

Two investigations were carried out: the first to determine the attenuation effect of headphones and rubber plaster mixing bowls; the second, to evaluate the reliability of certain tuning fork tests, which had been in question for years. Both investigations were conducted in a sound treated room with an ambient noise level of less than 24 db., when measured with a General Radio Co. noise level meter, Type 759-B.*

Investigation with Headphones. The matched headphones of a headset were encased in firm rubber and tested for the attenuation effect on spondee words in the free field, on the basis of normal threshold as determined by testing a group of persons. Observations in this test indicated that attenuation for high frequency in the order of 1,000 cps. and above was greater than for frequency below this figure. With this in mind, the attenuation effect of the headphones on PAL noise and on sawtooth noise was investigated. The PAL noise consists of thermal noise upon which is superimposed static that is composed of more high tones than low tones. Sawtooth noise is predominate in vibrations close to 128 cps. or below. First, the attenuation effect was determined when the headphones were clamped tightly over the ears, and second, when held in place by a regular headset.

A similar investigation was made with the headphones encased in sponge rubber.

Finally, rubber plaster mixing bowls, clamped over the ears so as to produce a slight vacuum, were tested for the effect on spondee words in the free field, on PAL noise and on sawtooth noise.

The findings of the investigation are shown in Chart 1. In comparing the attenuation value of headphones, encased in firm rubber and not clamped over the ears, with those encased in sponge rubber and not clamped, for spondee words on the basis of normal threshold tests, the former had an advantage

*The writer wishes to express his appreciation to Dr. Aram Glorig, Jr., and to Mr. Francis L. Sonday for their cooperation, and for permitting the use of the facilities at Forest Glen Aural Rehabilitation Center for these investigations.

CHART 1.

ATTENUATION VALUE OF HEADPHONES AND RUBBER PLASTER MIXING BOWLS.

	Position of Headphones	Spondee Words	PAL Noise	Sawtooth Noise
Two matched headphones encased in firm rubber	Clamped tightly over ears	25 db.	30 db.	14 db.
	Fitted with regular headset	20 db.	20 db.	4 db.
Two matched headphones encased in sponge rubber	Clamped tightly over ears	20 db.	14 db.	8 db.
	Fitted with regular headset	15 db.	4 db.	0 db.
Rubber plaster mixing bowls	Clamped tightly over ears so as to produce a slight vacuum	10-20 db.	28 db.	8 db.

of 5 db. over the latter. The attenuation effect of headphones encased in firm rubber, when not clamped tightly, was 20 db. for PAL noise, whereas they gave only 4 db. of attenuation for sawtooth noise. Rubber plaster mixing bowls clamped tightly so as to produce a slight vacuum had an attenuation effect of from 10 to 20 db. for spondee words, 28 db. for PAL noise and 8 db. for sawtooth noise.

Investigation with Tuning Forks. Three different tests were made in the effort to evaluate tuning forks in hearing tests. Six tuning forks were used in the investigation: two 512 magnesium, one 512 steel, two 1,024 magnesium, and one 1,024 steel.

The first test was performed with the intent of showing the intensity of sound transmitted from the stem of different tuning forks, when they were activated by different methods. Chart 2 shows the variation in volume of sound produced when the tuning forks were hit with a rubber percussion hammer, when they were hit on the knee, and when pinched. The tuning forks were first hit or pinched very hard, and then with what was considered average force. All readings were taken with the stem of the tuning fork balanced on the microphone of the noise level meter, using the tester's finger as a base.

CHART 2.

RESULTS OF DIFFERENT METHODS OF ACTIVATING TUNING FORKS' MEASUREMENTS TAKEN WITH TUNING FORKS BALANCED ON TESTER'S FINGER RESTING ON MICROPHONE.

Tuning Forks	Rubber Hammer		Hitting Knee		Pinch	
	HB	AB	HB	AB	HB	AB
1. 512 mg.	70	65	65	60	50	45
2. 512 mg.	68	65	65	60	50	45
3. 512 steel	65	60	60	55	55	50
1. 1,024 mg.	65	60	60	55	50	45
2. 1,024 mg.	65	60	60	55	50	45
3. 1,024 steel	55	50	50	45	45	40

All readings taken in decibels of intensity as measured on GRC meter, Type 759-B, weighting curve set at C. HB = hard blow; AB = average blow.

In the tests with the magnesium tuning forks of 512 cps. there was a variance in intensity of sound from a maximum of 70 db. to a minimum of 45 db. Steel tuning forks of 512 cps. showed a variation from a maximum of 65 db. to a minimum of 50 db. The 1,024 magnesium tuning forks showed a variation from a maximum of 65 db. to a minimum of 45 db. The 1,024 steel tuning forks showed a variation from a maximum of 55 db. to a minimum of 40 db.

The second test was made for the purpose of comparing the volume of sound emitted by tuning forks when they were activated by a rubber percussion hammer, by being hit on the knee, and by pinching, and then held one-half inch from the microphone. As shown in Chart 3, with the three different methods of activation, there was a maximum difference of 25 db. in the intensity of sound produced when the 512 magnesium tuning forks were tested, a maximum difference of 20 db. when the 512 steel tuning forks were tested, a maximum difference of 25 db. when the 1,024 magnesium tuning forks were tested, and a maximum difference of 15 db. when the 1,024 steel tuning forks were tested.

The third test was performed in the endeavor to compare the intensity of sound produced when the tuning forks were held in three different positions: *1.* when the stem of the tuning fork was balanced on the tester's finger as it rested on

CHART 3.

RESULTS OF DIFFERENT METHODS OF ACTIVATING TUNING FORKS' MEASUREMENTS TAKEN WITH TUNING FORKS HELD ON EDGE, ONE PRONG ABOVE THE OTHER, ONE-HALF INCH FROM MICROPHONE.

Tuning Forks	Rubber Hammer		Hitting Knee		Pinch	
	HB	AB	HB	AB	HB	AB
1. 512 mg.	100	90	90	85	80	75
2. 512 mg.	100	90	90	85	80	75
3. 512 steel	85	80	80	75	70	65
1. 1,024 mg.	100	95	95	90	80	75
2. 1,024 mg.	98	93	95	80	80	75
3. 1,024 steel	80	75	80	75	70	65

All readings taken in decibels of intensity as measured on GRC meter, Type 759-B, weighting curve set at C. HB = hard blow; AB = average blow.

the microphone; *2.* when the tuning fork was held on edge one-half inch above the microphone; and *3.* when the tuning fork was held on its side with the prongs parallel, one-half inch from the microphone. In this test all tuning forks were activated with a rubber percussion hammer.

As shown in Chart 4, there was a considerable variation in the intensity of sound produced when the tuning forks were

CHART 4.

RESULTS OF TESTS WHEN TUNING FORKS ACTIVATED BY A RUBBER PERCUSSION HAMMER AND HELD IN DIFFERENT POSITIONS.

Tuning Forks	Balanced with Finger on Microphone		Held on Edge, ½" from Microphone		Held on Side, ½" from Microphone	
	HB	AB	HB	AB	HB	AB
1. 512 mg.	70	65	100	95	92	85
2. 512 mg.	68	65	100	95	92	85
3. 512 steel	65	60	85	80	85	80
1. 1,024 mg.	70	65	100	95	100	95
2. 1,024 mg.	70	65	100	95	100	95
3. 1,024 steel	60	55	85	75	80	70

All readings taken in decibels of intensity as measured on GRC meter, Type 759-B, weighting curve set at C. HB = hard blow; AB = average blow.

held in the three different positions. The 512 magnesium tuning forks when balanced produced from 70 to 65 db. of intensity of sound; when held on edge, from 100 to 95 db.; and when held on the side, from 92 db. to 85 db. There was, therefore, a maximum difference of 35 db. in intensity of sound produced when the tuning forks were held in the three different positions. In a comparison of the volume of sound emitted when the 512 magnesium tuning forks were held on edge and on the side, there was a difference of from 8 to 10 db. in favor of the position on edge.

The maximum difference in intensity of sound produced in testing the 512 steel tuning forks was 25 db.; in testing the 1,024 magnesium tuning forks, 35 db.; and in testing the 1,024 steel tuning forks, 30 db.

The decrement of the tuning forks was measured. It was found that when the tuning forks were activated with a force as uniform as possible, there was a variance of from 0.66 db. a second to 1.75 db. a second. These figures closely approximate those established by Lierle and Reger.[23] The decrement of the steel tuning forks was found to be practically twice as fast as that of the magnesium tuning forks. This was due to the fact that tuning forks have different physical properties.

PRESENTATION OF HEARING TEST.

The clinical work underlying this test extended over a period of 18 months, but the majority of patients were tested for hearing loss in the period from July 1, 1948, to July 1, 1949. A total of 105 cases were studied. The series does not include any patient under eight years of age, or patients with language difficulty, or mental cases. Thirty-five of the patients were males; 70 were females. The age of the patients ranged from eight to 80 years.

Conditions Under Which the Tests Were Made. All tests were made in the writer's office, which is located in a modern office building. The room was 8 feet by 12 feet in size, and was an inside, air-conditioned room without windows. Two

walls, 6 and 8 inches thick, respectively, separated it from the hall corridor. The ceiling and walls were treated with acoustical plaster and covered with sound absorptive material. The doors were covered with sound absorptive material, and the jambs with strips of felt. The floor was heavily carpeted. In a room thus treated, the ambient noise level, when measured with the General Radio Co. noise level meter, Type 759-B, was 37— db. This reading was determined by averaging the maximum and minimum readings for three settings on five different occasions (see Chart 5).

CHART 5.

DETERMINATION OF AMBIENT NOISE LEVEL OF ROOM USED FOR CLINICAL WORK.*

Sound Level Range	Weighting Curve	Readings		Ambient Noise Level of Room†
		Max.	Min.	
24- 55 db.	A (40 db.)	38 db.	28 db.	
55- 85 db.	B (70 db.)	37 db.	34 db.	37— db.
85-140 db.	C (equal response over entire range)	47 db.	43 db.	

*All readings made on GRC sound level meter, Type 759-B.

†The average was obtained by taking the average of the maximum and minimum readings.

When tests are carried out in a room with an ambient noise level of 37— db. and headphones are used that produce 20 db. of attenuation. the ears are actually being tested in an ambient noise level of 17 db.

A modern audiometer and two-speed turntable were used in making all tests. The audiometer was equipped with a microphone, two matched headphones encased in firm rubber, a bone conduction receiver, a high fidelity playback system provided with a trimmer for the reproduction of recordings, and a zero-power level meter. The audiometer was also provided with a calibrated white noise for masking, and another available masker was an air jet. The entire system was equipped with a silent interrupter switch.

Before any tests were made, the audiometer was calibrated for normal speech and pure tone levels under the conditions

which were to be used in making the tests. This was accomplished in the following manner: Ten persons whose hearing was known to be normal were tested for air conduction and bone conduction, using pure tones, spondee words (Auditory Test 9), the PB 50-word lists, and connected discourse. The group included three children of 12, 13 and 14 years of age; three college students of 19, 20 and 21 years of age; and four adults of 35, 38, 40 and 45 years of age. The average for each of the tests was taken as normal. Throughout the investigation the corrective factor was used.

Although 10 persons, that is, 20 ears, with normal hearing were used to standardize the equipment in this particular study, it is the writer's opinion that four persons, that is, eight ears, are sufficient. Each six months the system should be recalibrated, using four persons, that is, eight ears.

Method of Procedure. A complete history was taken of each case, including the age, sex, marital status, childhood diseases, past illnesses, and the most recent serious illness. Information relative to the hearing loss was obtained by questioning the patient, or parent, as follows:

1. Is the hearing constant or does it vary?
2. Is the hearing better in a noisy or quiet place?
3. Is there trouble hearing at church, at the movies, on public conveyances, in groups, or on the telephone? Name in the order in which hearing is most troublesome.
4. Is the hearing average, better, or worse today?
5. How long since the last upper respiratory infection?
6. Is there any family history of deafness?
7. When and under what conditions was the hearing loss first noticed?
8. Do you know of any possible cause of hearing loss?
9. Has tinnitus, vertigo, dizziness or allergy been experienced?
10. What was the number of pregnancies and was the hearing affected?

When the history of the case had been obtained, a complete ear, nose and throat examination was made. This was followed, if indicated, by a complete physical examination, blood tests and Roentgenographic examination.

Before any tests were made for either pure tones or speech reception, the patient was first allowed to hear the pure tones and to see a group of words similar to those to be used. Detailed instructions were given as to what to expect during the test. This familiarizing the patient with the procedure is felt to be of inestimable value.

Pure Tone Test: The pure tones air conduction test was made by taking the average of the readings for the following three approaches to threshold: *1.* the threshold was approached from above in 5 db. steps; *2.* the threshold was approached from below in 5 db. steps; and *3.* the threshold was approached from below in 5 db. steps, and at each step the tone was interrupted at the rate of once a second. All air conduction tests started at 1,024 cps. and went first up the scale to 8,192 cps., and then down the scale from 512 cps. to 128 cps. It was observed that the findings for the range of 512, 1,024 and 2,048 cps. did not vary in all three methods by more than 2 db.; however, in the tones of 4,096 cps. and 8,192 cps., when the threshold was approached from below and the tones were interrupted, it was observed that the threshold was lowered by an average of 5 db. at 8,192 cps., and from 3 to 5 db. at 4,096 cps. It was also observed that when the threshold was approached from below threshold in tones of 256 cps. and 128 cps., the threshold was raised by 5 db. In perceptive deafness, this lowering of from 3 to 5 db. in the higher tones was consistently present. In conductive deafness, the 3 to 5 db. of elevation in threshold in tones below 512 cps. was consistently present.

Readings for bone conduction were taken for 512, 1,024, 2,048 and 4,096 cps. It was noted that when pressure was made on the bone conduction receiver, a lowering of 5 db. could be elicited. A similar lowering was elicited when a regular headset was used, and a piece of sponge rubber, two inches thick, placed under the headset on the opposite side of

the head, simulating the pressure on the bone conduction receiver that would be produced with a head of larger size. In all bone conduction tests, masking slightly above the threshold of the ear not being tested was used.

Speech Reception Tests: Auditory Test 9 was used for threshold determination for speech. This test consists of a total of 84 spondaic words, which are words of two syllables equally stressed, such as hotdog, railroad and cookbook. Each record of 42 words is in a different scrambling. The lists are recorded in groups of six words progressively lowered by 4 db. steps. The threshold reading for this test is the level at which a patient can repeat correctly 50 per cent of the words. Hudgins, *et al.*,[16] have worked out the method of determining this level. It is of the utmost importance in using Auditory Test 9 that the attenuation is set high enough so that a patient can repeat correctly all of the first six words.

In order to test discrimination, the PB 50-word lists, which were developed at the Psycho-Acoustic Laboratory and recorded in the Technisonic Laboratory at Central Institute for the Deaf, were used. Each list contains 50 words, all of which are monosyllables, phonetically balanced, and which represent proportionately the sounds in the English language as it is spoken. The settings used were 25 db. above the threshold as determined by spondee words, and the maximum intensity tolerated by the patient. It was felt that the setting 25 db. above the threshold as determined by spondee words was best for diagnostic purposes. Seldom would a patient tolerate a maximum intensity of 120 db. In perceptive deafness, as the attenuation was increased above threshold, the score for the PB 50-word lists did not increase, but rather it had a tendency to fall, whereas in conductive deafness, discrimination rose. In conductive deafness, the PB reading for prognostic value was taken at the maximum level; in perceptive deafness it was taken at the maximum comfortable level.

The PB 50-word lists were used both with and without a carrier phrase. It was observed that the carrier phrase, "You will say," had the distinct advantage in young children and in the very old of alerting the patient, and keeping his atten-

tion focused on the problem at hand. Curiously enough, a selected few of the more intelligent patients thought that the carrier phrase was monotonous.

A connected discourse test was made, utilizing records of a speech by Fulton Lewis, Jr., and of some recent broadcasts over the NBC System. The most comfortable level for connected discourse was found to be 12 db. above the threshold at which the patient could, with effort, understand each word.

From the readings of Auditory Test 9 and the PB 50-word lists, it was possible by using Davis' chart, the Social Adequacy Index (SAI) for Hearing, to quantitatively evaluate the hearing loss, and to predict just how much improvement might be expected with a hearing aid, or from auditory training, or from a successful fenestration operation.

COMMENT.

A sound treated room is absolutely essential in detecting early hearing loss. The ambient noise level should not be above 45 db. when measured with a weighting curve set at C (equal response over entire range). It is true that the sound level meter does not react just as the human ear, but, nevertheless, it is one of the most practical methods for measuring sound or noise. It is a device, not for measuring frequency and pitch, but for measuring the amplitude of rapid alterations in air pressure. When such alterations occur within a given range of frequency, the ear interprets them as sound or noise. All findings are, therefore, subjective. With a sound level meter, on the other hand, all measurements are objective, since they are unaffected by the many human variables, such as prejudices, likes or dislikes, which enter into any sort of human estimates of loudness.

Charts 6, 7, 8 and 9 show very clearly the importance of using a sound treated room in evaluating early hearing loss.

From an investigation of the attenuation effect of headphones, it was found that with properly constructed and well fitted headphones, it is possible to lower the ambient level of

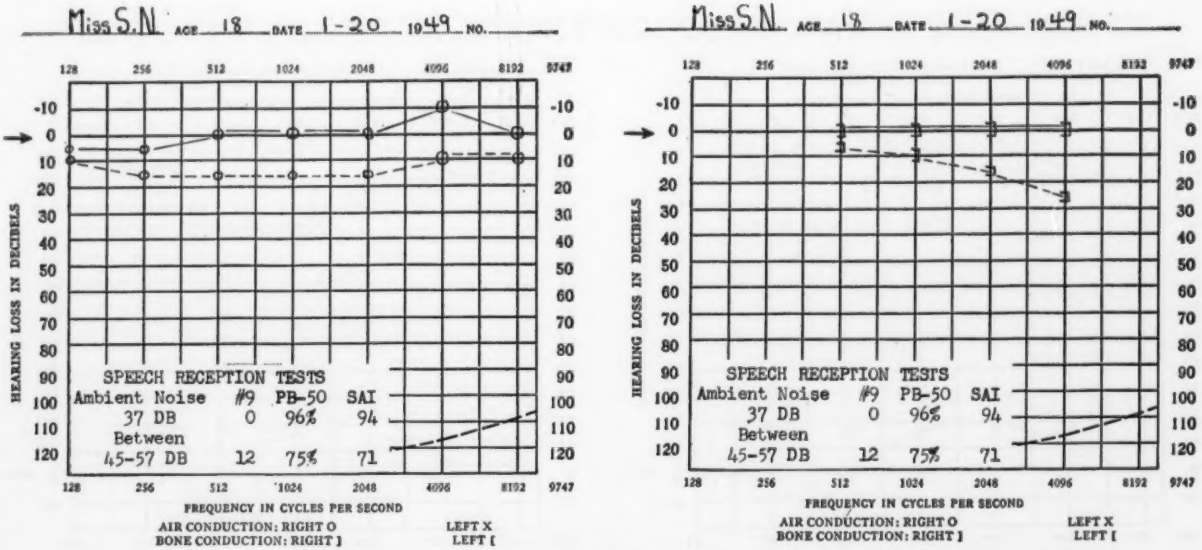
Miss S.N. AGE 18 DATE 1-20 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 0 96% 94
Between
45-57 DB 12 75% 71
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O
BONE CONDUCTION: RIGHT]
LEFT X
LEFT [
Miss S.N. AGE 18 DATE 1-20 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 0 96% 94
Between
45-57 DB 12 75% 71
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O
BONE CONDUCTION: RIGHT]
LEFT X
LEFT [

Chart 6. Case 1. S. N. Effects of ambient noise in testing a patient with normal hearing. Solid line indicates tests in room with ambient noise level of 37 db. Dotted line indicates tests in same room with doors open, ambient noise level of from 45 to 57 db.

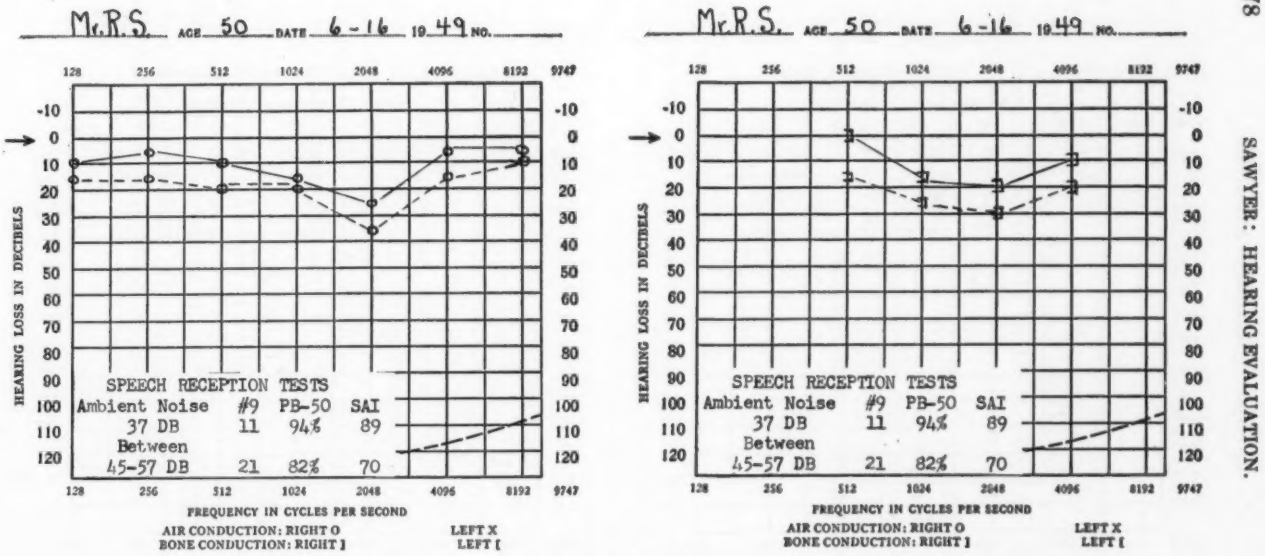
Mr. R. S. AGE 50 DATE 6-16 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 11 94% 89
Between
45-57 DB 21 82% 70
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O LEFT X
BONE CONDUCTION: RIGHT] LEFT [
Mr. R. S. AGE 50 DATE 6-16 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 11 94% 89
Between
45-57 DB 21 82% 70
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O LEFT X
BONE CONDUCTION: RIGHT] LEFT [

Chart 7. Case 2. R. S. Effects of ambient noise in testing a patient with slight loss of hearing. Solid line indicates tests in room with ambient noise level of 37 db. Dotted line indicates tests in same room with doors open, ambient noise level of from 45 to 57 db.

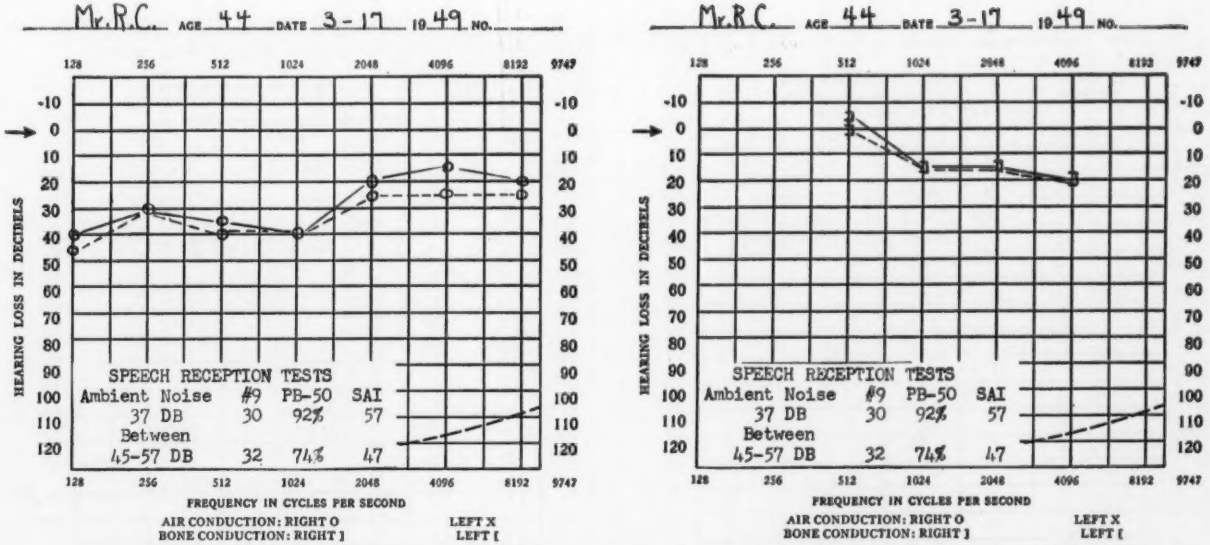
Mr. R. C. AGE 44 DATE 3-17 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 30 92% 57
Between
45-57 DB 32 74% 47
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O LEFT X
BONE CONDUCTION: RIGHT] LEFT [
Mr. R. C. AGE 44 DATE 3-17 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 30 92% 57
Between
45-57 DB 32 74% 47
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O LEFT X
BONE CONDUCTION: RIGHT] LEFT [

Chart 8. Case 3. R. C. Effects of ambient noise in testing a patient with otosclerosis (conductive deafness). Solid line indicates tests in room with ambient noise level of 37 db. Dotted line indicates tests in same room with doors open, ambient noise level of from 45 to 57 db.

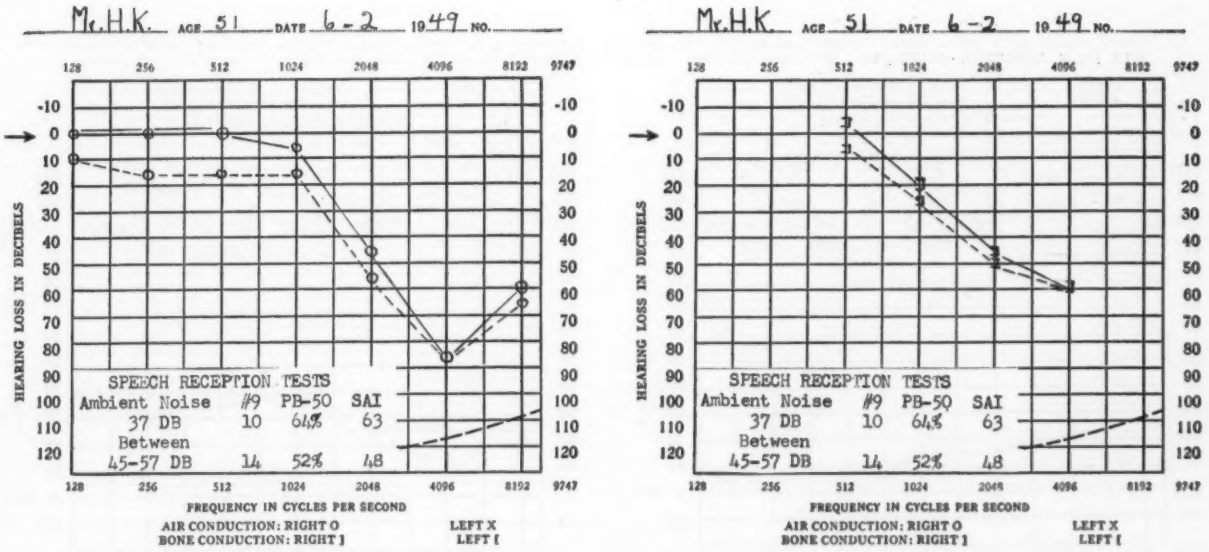
Mr. H.K. AGE 51 DATE 6-2 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 10 64% 63
Between
45-57 DB 14 52% 48
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O
BONE CONDUCTION: RIGHT]
LEFT X
LEFT [
Mr. H.K. AGE 51 DATE 6-2 1949 NO.
128 256 512 1024 2048 4096 8192 9747
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
HEARING LOSS IN DECIBELS
SPEECH RECEPTION TESTS
Ambient Noise #9 PB-50 SAI
37 DB 10 64% 63
Between
45-57 DB 14 52% 48
FREQUENCY IN CYCLES PER SECOND
AIR CONDUCTION: RIGHT O
BONE CONDUCTION: RIGHT]
LEFT X
LEFT [

Chart 9. Case 4. H. K. Effects of ambient noise in testing a patient with nerve deafness (perceptive deafness). Solid line indicates tests in a room with ambient noise level of 37 db. Dotted line indicates tests in same room with doors open, ambient noise level of from 45 to 57 db.

the external auditory canal by an average of 20 db. below the ambient noise level of the room, providing tests are made in a room with an ambient noise level in the neighborhood of 1,000 cps. or above. A similar lowering may be produced by the use of one headphone and a dummy headphone, or a rubber plaster mixing bowl, clamped tightly over the ear not being tested.

For many years, attempts have been made to standardize bone conduction tests, but this has been practically impossible. In the first place, little is known about the transmission of sound through skin and bone; moreover, there is a wide variation in the structure of human heads. It has also been pointed out by physicists that sound waves are not easily transmitted from one medium to another of different acoustic resistance.[36]

The investigation with tuning forks, which has been described in this paper, shows that tests with tuning forks, due to the differences in their size and physical properties, have very little, if any, value; furthermore, the volume of sound produced varies with the method of activation and the position in which the tuning fork is held. In spite of making a great effort to activate the tuning forks with the same force, a variation of from 5 to 10 db. in the intensity of sound produced was noted in the investigation. In the opinion of the writer, tuning fork tests are of value only for gross comparisons, and their usefulness will be in direct proportion to the experience of the tester.

In the use of the electrically activated bone conduction receiver, some discrepancies are encountered; however, when the bone conduction receiver is properly standardized, reasonably dependable readings may be obtained for purposes of comparison.

Properly made recordings, when reproduced over a high fidelity system, afford a simple but reliable method of testing speech reception. All physical factors can be measured objectively. It is the nearest approach to objective evaluation of hearing loss that we have at the present time. It is, of course, impossible to measure objectively the purely nervous factor

of hearing, which is subject to all the variables found in humans, and is obviously subjective in value. The cooperation of the patient is a factor that cannot be controlled. For this reason, the evaluation of hearing loss as determined with the use of recordings over a playback system will be in direct proportion to the cooperation of the patient, as well as to the reliability of the system and the experience of the tester, the latter two factors being controllable.

The monitored live voice has not been used in the tests. It is felt that the physical equipment required for its use is too elaborate. The same reliable evaluation of hearing loss can be obtained by using recordings, and the latter also have the advantage of permitting repeated tests at the same level without any question of human variables.

The Social Adequacy Index (SAI) for Hearing, which Hallowell Davis[8] prepared in his meticulous manner, and presented in 1948, fulfilled the long standing need for proper quantitative evaluation of hearing loss for speech. There had been need of such quantitative evaluation of hearing loss, not only for medicolegal purposes, but more particularly to determine the value of hearing aids, auditory training, and successful fenestration operations. The SAI for Hearing establishes the relationship between a patient's hearing loss for speech and the level of his plateau. For the first time, it is possible to give a patient an understandable prognosis. In the opinion of the writer, the SAI for Hearing will, in the future, be as valuable with relation to speech reception tests as the audiogram is with relation to pure tones tests.

CONCLUSIONS.

Hearing loss for speech and pure tones may be properly evaluated by using the following minimum physical equipment and tests:

1. *Physical Equipment:*

   A sound treated room with an ambient noise level of not more than 45 db. when measured with the weighting curve C (equal response over entire range).

A modern audiometer equipped either with two headphones encased in firm rubber, or with one headphone and a dummy headphone, or a rubber plaster mixing bowl, over the ear not being tested.

A reliable playback system equipped with a trimmer and a zero level meter for the reproduction of recordings.

All equipment including recordings must be standardized under the conditions to be used in the tests.

The above equipment requires a financial outlay of less than $1,000.

2. *Essential Tests:*

Air conduction for pure tones from 128 cps. to 8,192 cps., the two extremes being of questionable value.

Bone conduction for 512, 1,024, 2,048, 4,096 cps., which furnishes a clue and helps to round out the overall picture.

Speech reception tests using:

Spondee words (Auditory Test 9) for the determination of threshold.

PB 50-word lists given at 25 db. above threshold for diagnostic purposes, and at the maximum intensity tolerated by the patient for prognostic purposes.

By means of the Social Adequacy Index (SAI) for Hearing, it is possible to quantitatively evaluate the hearing loss for speech.

In the final analysis, hearing tests to have any value must be meticuously performed under proper conditions. Such tests, when combined with the complete history of the case and physical examination, present a reliable basis for hearing evaluation.

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TUMORS OF THE TRACHEA.*†

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Tumors of the trachea are relatively rare. According to various authorities they range in frequency from one to three hundred, to one to eight hundred as compared to tumors of the larynx. They are not usually recognized until they are far advanced, because no localizing symptoms develop until they become large enough to produce severe respiratory obstruction.[28]

Twenty-eight cases of tracheal tumors seen at The Research and Educational Hospitals, St. Luke's Hospital and The Children's Memorial Hospital during the past 14 years are reviewed. They may be classified as nonspecific and specific inflammatory tumors, and benign and malignant neoplasms. Eighteen of the 28 tumors were primary in the trachea. The remaining 10 tumors invaded the trachea from adjacent structures to give signs, symptoms and endoscopic findings of primary tracheal tumors.

Summaries of the histories, findings and therapy are given in the accompanying tables. Table I lists the data of the patients found to have inflammatory tumors in the trachea. Five of the tumors are placed in this category; two are examples of nonspecific post-tracheotomy granulomas that caused respiratory obstruction which prevented extubation or required endoscopic removal after extubation. These two

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cases are representative of numerous similar cases in which the presence of granulomas around the tracheotomy tube at the point of the tracheostomy caused definite delay in extubation following tracheotomy. In one of the two cases exuberant granulation tissue was found to prevent extubation, the tracheotomy tube still being *in situ*. In the second case, a three-year-old boy, wheezing and dyspnea recurred 10 days after the tracheotomy tube had been removed. Lateral X-rays of the neck demonstrated a round shadow in the trachea at the site of the previous tracheostomy (see Fig. 1). Passage of the bronchoscope to this portion of the trachea demonstrated a granuloma almost completely obstructing the trachea. The tumor was dislodged with the tip of the bronchoscope and a normal airway was re-established. A similar coring technique was used in removing the granuloma from the trachea of the other patient, the tracheotomy tube being removed as the bronchoscope approached the tracheostomy.

These and other similar nonspecific inflammatory granulomas are of considerable clinical importance.[28] They are seen as tumors around foreign bodies of long standing within the trachea or bronchus, and as masses obstructing a bronchus leading to a segment of lung involved in a lung abscess. Their significance is that they produce both a respiratory obstruction and an obstruction to adequate drainage.

Three of the inflammatory tumors are the result of specific inflammatory disease. One of these tumors was a large tuberculoma that together with tuberculous ulceration and exudate eventually caused the death of the patient from tracheal obstruction. A second specific inflammatory tumor was due to torula. This tumor obstructed the trachea and right bronchus of a six-year-old boy. It was removed endoscopically. The following is the case report of this patient.

D. T. (Case 4, Table I), six years of age, male, was admitted to The Research and Educational Hospitals on Oct. 25, 1945. His symptoms began with wheezing in January, 1944, and he received treatment for asthma until it was discovered that breath sounds were absent in the right chest. Dyspnea gradually increased and a tracheotomy was done elsewhere in April, 1944. No relief of the dyspnea followed; therefore, the tube was removed a short time later. He continued to have recurrence of acute obstructive symptoms, but these moderated with penicillin

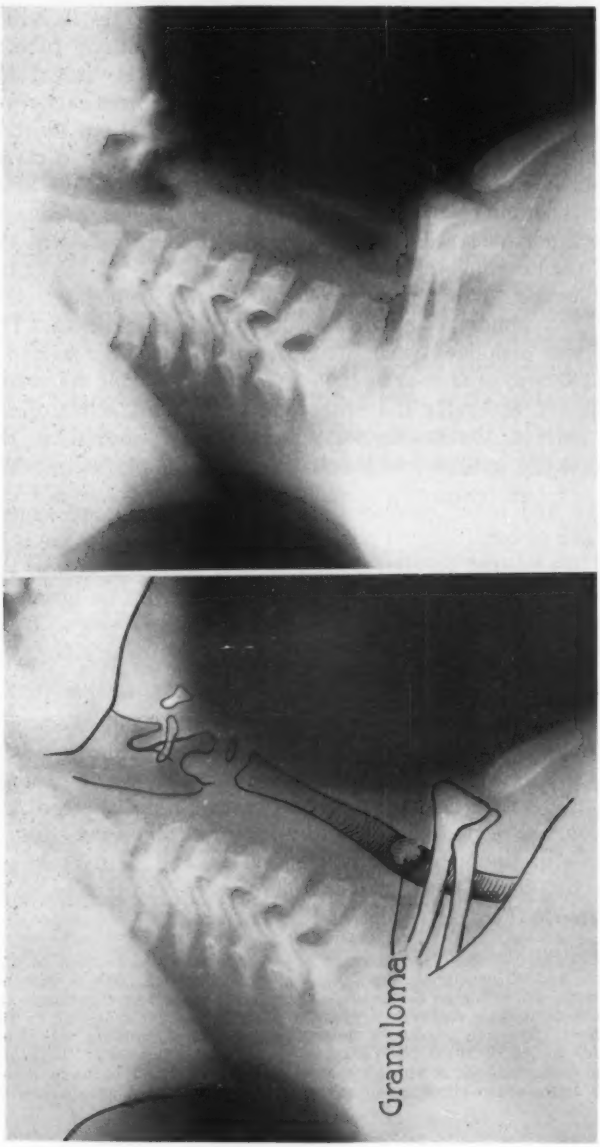

Fig. 1. (Case 2, Table I). Lateral X-rays of the neck demonstrating a nonspecific post-tracheotomy granuloma in the trachea at the site of the tracheostomy.

TABLE 1.

No.	Name and Sex	Age at Onset	Age on Admission	Symptoms and Laboratory	X-ray	Endoscopy	Therapy	Result	Diagnosis
1.	M.L. male	8 mos.	8 mos.	Tracheal obstruction; tracheotomy	Obliteration of shadow of airway proximal to tracheotomy tube.	Granuloma, anterior tracheal wall at tracheostomy.	Endoscopic removal.	Extubation following removal of granuloma; cured.	Post-tracheotomy granuloma
2.	J.D. male	3 yrs.	3 yrs.	Tracheal obstruction 10 days after extubation.	Granuloma at site of previous tracheostomy.	Granuloma at site of tracheostomy.	Endoscopic removal.	Cured.	Post-tracheotomy granuloma
3.	A.H. female	25 yrs.	26 yrs.	Sneeze, cyanosis; sputum positive for tuberculosis.	Bilateral pulmonary tuberculosis	Tracheal granuloma and exudate obstructing tracheal lumen.	Endoscopic removal. Biopsy: Tuberculoma.	Died.	Tuberculous granuloma of trachea
4.	D.T. male	4 yrs.	6 yrs.	Sneeze, cyanosis; atelectasis, right lung. Torula grown from tissue removed from trachea.	Atelectasis, right lung; planograms demonstrate tracheal tumor.	Mass above carina.	Endoscopic removal. Biopsy: Torula	Improved; trachea clear; bronchiectasis, rt. lung.	Torula of trachea
5.	T.McL. male	36 yrs.	46 yrs.	Wheezing and hoarseness; tightness in throat.	Dense nodular infiltration of tracheal cartilages.	Smooth, hard, nodular indentations into tracheal lumen.	None	Unchanged	Nodular calcification of tracheal cartilages

treatment. On Sept. 1, 1945, he was re-examined and found to have a complete atelectasis of the right lung; a bronchoscopic examination was made and tissue obtained from the trachea which established the diagnosis of Cryptococcus hominis (torula). At the time of admission to The Research and Educational Hospitals, approximately two months later, he had a persistent productive cough and was dyspneic and cyanotic. Physical findings and X-rays demonstrated an almost complete atelectasis of the right lung, with the apex beat of the heart to the right of the sternum, and an emphysema of the left chest. Laboratory studies showed hemoglobin 12.6, red blood cells 4,300,000 white blood cells 15,000, with an essentially normal differential count. The Kahn test was negative; blood chemistry studies, urinalysis and the electrocardiogram were normal. Skin and sputum studies, including guinea pig inoculation, were negative for tuberculosis. Histoplasma and coccidioidin skin tests were negative. Planographic studies demonstrated a tumor obstructing the distal trachea and entrance of the right main bronchus (see Fig. 2). There was no X-ray evidence of metastases to the spine or ribs. A bronchoscopic examination was made with oxygen flowing through the bronchoscope, and a large soft mass seen obstructing the tracheal lumen above the bifurcation. Sufficient tissue was removed to improve the airway and the procedure then discontinued. Histologic examination and tissue cultures confirmed the diagnosis of torula. A bronchogram three months later, after repeated bronchoscopic removal of obstructing tissue had established a normal lumen, showed a bronchiectasis of the right lung; however, after consultation with the department of thoracic surgery, a pneumonectomy was not advised because of the previous evidence of involvement of the trachea and right bronchus at the point at which the resection would have had to be done. This boy has remained symptom-free. During the month of December, 1945, this patient's father was also a patient in The Research and Educational Hospitals and succumbed to a brain abscess which followed pneumonia. No evidence of torulosis could be demonstrated on anti- or postmortem.

The fifth patient in the group of inflammatory tumors (see Case 5, Table I) had extensive calcification of the tracheal cartilages with nodular masses protruding into the lumen of the trachea (see Fig. 3). These were coverd by mucosa and presented the picture of tracheopathia osteoplastica. Careful medical and X-ray surveys showed no abnormal calcium metabolism and no unusual calcium deposits elsewhere.

Of the neoplastic tumors of the trachea reported in this series, five were benign and nine malignant. The benign tumors include one fibroma and one papilloma of the trachea, two amyloid tumors and one adenoma. The following three case histories of a fibroma, an amyloid tumor and an adenoma are representative of patients in this group:

W. L. (Case 7, Table II), 33-year-old white female, entered St. Luke's Hospital on Oct. 9, 1947. She gave a history of progressive trouble in breathing of one year's duration. For the previous two months the

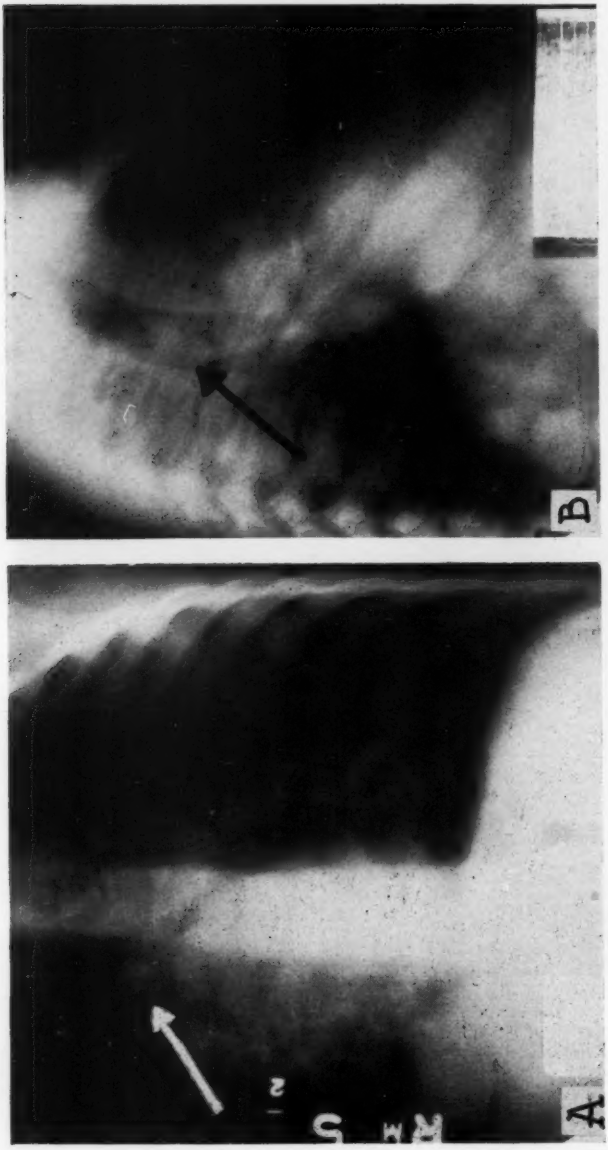

Fig. 2. (Case 4, Table I). Planograms showing tumor due to torula obstructing the trachea and entrance to the right main bronchus.

Fig. 3. (Sase 5, Table I) Planogram showing nodular obstructing calcification of the tracheal cartilages.

patient had been unable to lie down to sleep. The dyspnea was primarily inspiratory. She was taken to the operating room on admission, and an emergency tracheotomy was performed, using a Mosher lifesaver to

TABLE 2.

No.	Name and Sex	Age at Onset	Age on Admission	Symptoms and Laboratory	X-ray	Endoscopy	Therapy	Result	Diagnosis
6.	R.K. male	57 yrs.	58 yrs.	Hoarseness, hemoptysis, wheezing respiration leukemia	Chest film negative	Mass occluding trachea, 17 cm. from upper teeth. Biopsy: Papilloma	Endoscopic forceps reroval	No recurrence of tracheal tumor 4 yrs. later. Died of leukemia.	Papilloma of trachea; chronic lymphatic leukemia
7.	W.L. female	32 yrs.	33 yrs.	Cough; dyspnea	Mass on post-tracheal wall below cricoid cartilage	Pedunculated, round mass attached to post-tracheal wall. Biopsy: Fibroma	Endoscopic forceps removal. Tracheotomy	Cured. Tracheotomy tube removed.	Fibroma of Trachea
8.	L.D. male	72 yrs.	74 yrs.	Asthmatic wheeze; acute respiratory obstruction	None pre-operatively because of acute obstruction. Chest film negative.	Soft mass in mid-trachea "cored" with bronchoscope. Biopsy: Amyloid Tumor	Endoscopic "coring" with bronchoscope to establish lumen. Later forceps removal.	Improved. Residual amyloid tissue.	Amyloid Tumor of Trachea
9.	L.P. female	34 yrs.	40 yrs.	Wheeze, dyspnea, cough. Previous history of positive sputum. Sputum negative on admission	Homogenous density, rt. upper lobe	Narrowing of tracheal and bronchial walls by soft friable tissue. Occlusion, rt. upper lobe bronchus.	Endoscopic removal by coring and forceps. Xray therapy	Improved. Residual amyloid tissue.	Amyloid disease of trachea and bronchi.
10.	S.S. female	37 yrs.	43 yrs.	Wheeze, cough, dyspnea, orthopnea, "Status asthmaticus"	Chest X-ray negative. Planograms showed round tumor in mid-trachea	Smooth, pedunculated round mass occluding mid-trachea. Biopsy: Adenoma	Endoscopic forceps removal. Electro-resection.	Improved. Residual adenoma.	Adenoma of Trachea

establish the airway during the procedure. A No. 5 tracheotomy tube was inserted in the midline of the trachea. Subsequent examination showed a tumor attached to the right posterolateral wall of the trachea at the level of the second ring. This was removed with cup forceps at its pedicle. One week later a residual 3 mm. nodule was removed from the site of the tumor and the base electrocoagulated. The pathologist reported the tumor to be a fibroma with lipid deposits and reactive fibroplastic tissue, and suggested the possibility that the tumor might be a metastasis from the kidney. Pyelograms and urinalyses revealed no disease of the genitourinary tract, and complete blood studies for lipid metabolism revealed no abnormality. The blood count and Kahn test were normal. The patient has been well following the removal of the tumor.

L. D. (Case 8, Table II), a 74-year-old white male, entered St. Luke's Hospital, Feb. 13, 1948. He gave the history of having experienced difficulty in breathing for two years. At the onset the dyspnea occurred with colds and was relieved by adrenalin. During the next few months the attacks became more severe, though not more frequent, and adrenalin became ineffective. In December, 1947, a very severe attack occurred, followed by complete relief for two months. In the week previous to admission the patient had had three severe attacks of dyspnea and cyanosis. On arrival at St. Luke's Hospital as an emergency, the patient became unconscious and was taken immediately to the operating room. A bronchoscope was passed through the larynx without anesthesia; 5 cm. below the cords the trachea was found to be almost completely obstructed by soft, pale tissue. The bronchoscope was advanced through the area into the right bronchus, "coring" the mass to create a lumen; the core was removed from the bronchoscope and the airway thus re-established. With oxygen and artificial respiration normal breathing was gradually resumed. The histologic report of the tissue obtained was "amyloid deposits in tracheal tissue." The patient was then given Congo red and subsequent tissue removed bronchoscopically was supravitally stained red with the dye. This tissue also gave the iodine test for amyloid. Five days later bronchoscopy was repeated, and large pedunculated pieces of tumor were removed, and the airway enlarged. A third bronchoscopy was performed one week later. The entire circumference of the trachea was involved as far as the coryna.

Urinalysis revealed an albuminuria and occasional hyaline casts. The blood count was normal. Blood chemistry revealed 60 per cent Congo red in the blood; this indicated 40 per cent retention, an abnormal finding. Bronchoscopy eight months after discharge from the first admission revealed a roughened trachea with good airway. No other site of amyloid infiltration has been found in this patient.

S. S. (Case 10, Table II), a 43-year-old white woman, entered St. Luke's Hospital, Jan. 24, 1949. She gave a history of having had difficulty in breathing, with asthmatic wheezing for the past six years. Breathing had become increasingly difficult during the past year. Three series of allergy tests had been made because of persistent asthma. There was a slight nonproductive cough. A bronchoscopic examination had been made elsewhere, at which time a tracheal tumor had been found almost completely obstructing the trachea, and the patient was referred for removal of the tumor. X-ray studies prior to bronchoscopy by planographic technique in the anteroposterior and lateral views showed a round tumor 1 cm. in diameter attached to the posterior wall of the trachea in its midportion (See Fig. 4. Bronchoscopic examination showed the tumor to be round, slightly nodular and covered with smooth mucosa with large

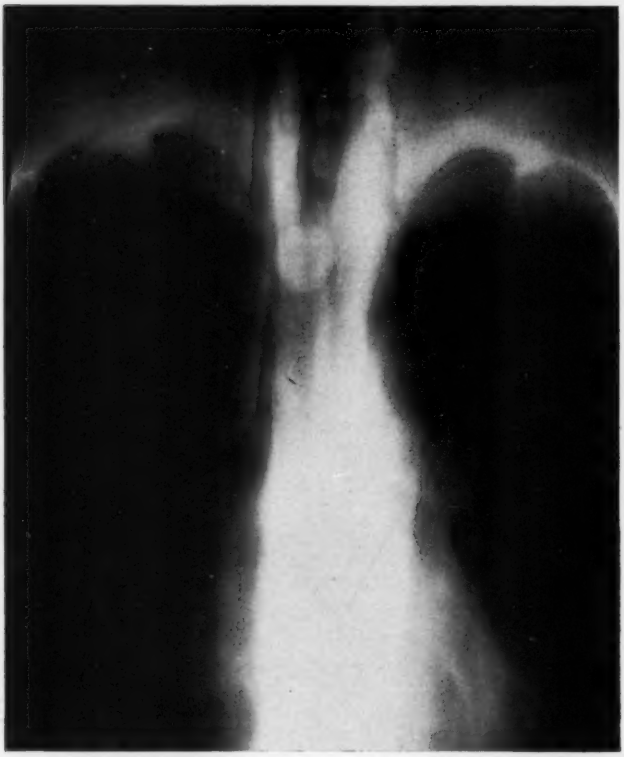

Fig. 4. (Case 10, Table II). Planogram in A-P projection at 6 cm. level showing round tumor obstructing the midportion of the trachea. Histologic study showed the tumor to be an adenoma.

vessels on its surface. Except for a small slit on the anterior and left tracheal wall the tumor obstructed the entire lumen of the trachea. The 12 mm. photographic bronchoscope was passed directly over the tumor, removing it nearly *in toto*. An attempt to coagulate the base was interrupted by bleeding. The examination was continued three days later, further tissue removed and the base of the tumor coagulated. The tumor proved to be an adenoma of the trachea. Laboratory data were essentially normal. The patient is asymptomatic at this time, but tracheoscopy has demonstrated residual adenomatous tissue on the posterior tracheal wall. Further tissue has been removed with the resectascope,[23] using the cutting loop and then coagulating the base of the lesion with the electrocoagulating current (see Fig. 5).

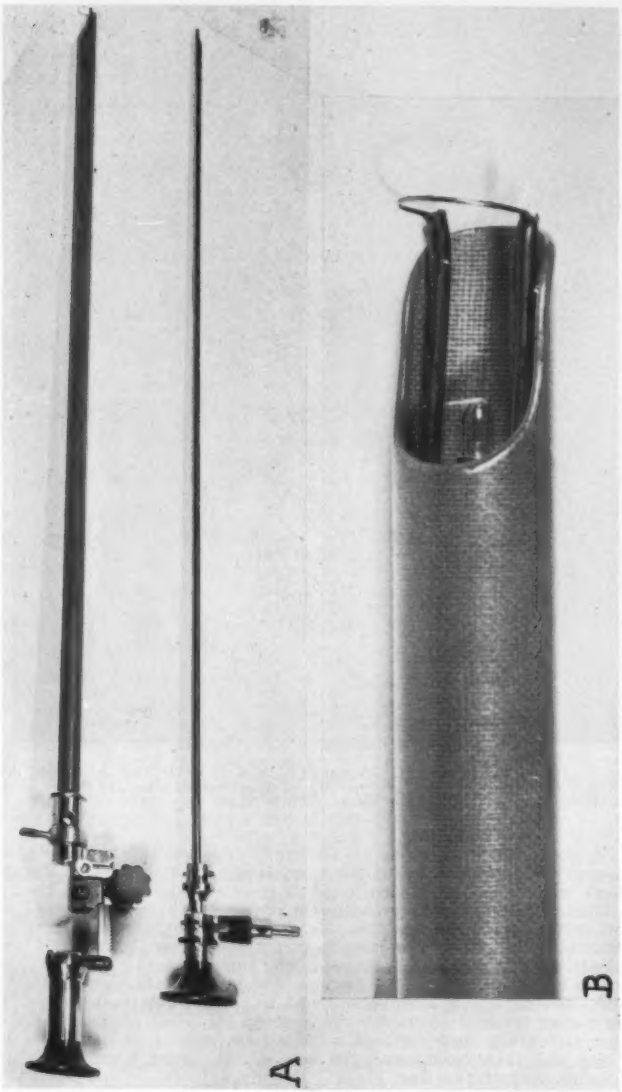

Fig. 5. (A) Resectoscope similar to cystoscopic resectoscope used with cutting loop or coagulating tip in cases of tracheal tumors. (B) Close-up of tip of scope and cutting loop.

Of the benign tumors of the trachea reported in the literature, the fibroma appears to be the most frequent,[3,18,26,31,42] and the papilloma[6,13,30] next in order of incidence. In patients who have papilloma of the trachea the primary source is almost always found in the larynx, the tracheal growths representing either extension of the growths downward or isolated transplants. Primary papilloma of the trachea without laryngeal involvement is rare.[6,24] Amyloid tumors,[45] tracheopathia osteoplastica,[10,38] and adenomas which are difficult to classify,[44,48] complete the list of benign neoplastic tumors of the trachea encountered, although lipomas, angiomas,[25] and chondromas are occasionally seen.[39]

The nodular tumors of rhinoscleroma should be included in this discussion.[37,46] Although these have not been seen in the cases herein reported, they are being seen with increasing frequency in this country.[34]

The malignant tumors constitute the largest group of primary tracheal tumors both from the standpoint of a review of the literature and from the cases herein reported.[2,4,11,12,14,16,17,20,32,40,47] Five of the nine primary malignant tumors in this series were squamous cell carcinoma, one was an adenocarcinoma, and one a cylindroma. Two cases of myosarcoma of the trachea, previously reported,[22] are included for statistical purposes. The history of a case representative of this group is as follows:

W. R. (Case 11, Table III), 45-year-old white male, entered the Research and Educational Hospitals on Sept. 25, 1945. He stated that he first noted difficulty in breathing and exercising during the previous winter. A severe cough was associated with wheezing and occasional hemoptysis. In April, 1945, a biopsy was taken elsewhere from the posterior wall of the trachea below the larynx, establishing the diagnosis of carcinoma of the trachea. Thirty-four X-ray treatments (4,250 r.) were given and in March, 1945, a tracheotomy was done for increasing dyspnea. The lesion progressed and 18 additional X-ray treatments (3,600 r.) were given. A direct laryngoscopy and tracheoscopy on Oct. 2, 1945, revealed tumor tissue on the posterior wall of the trachea, partly obstructing the airway. Biopsy showed persistent anaplastic squamous cell carcinoma. Serology and red and white blood cell counts were normal. Since no response had been obtained with X-ray, the patient was surgically explored on Oct. 16, 1945, in an attempt to remove the larynx, upper trachea and esophagus. Mediastinal glands and extension to the esophagus were discovered and the operation discontinued. The patient had progressive difficulty as the carcinoma extended further into the esophagus, and

when he could no longer maintain adequate nutrition orally a Witzel gastrostomy was done. This was performed on March 12, 1946, over a year after the onset of his symptoms. He expired on April 15, 1946.

The malignant tumor encountered most frequently in this series is squamous cell carcinoma (see Fig. 6). In other re-

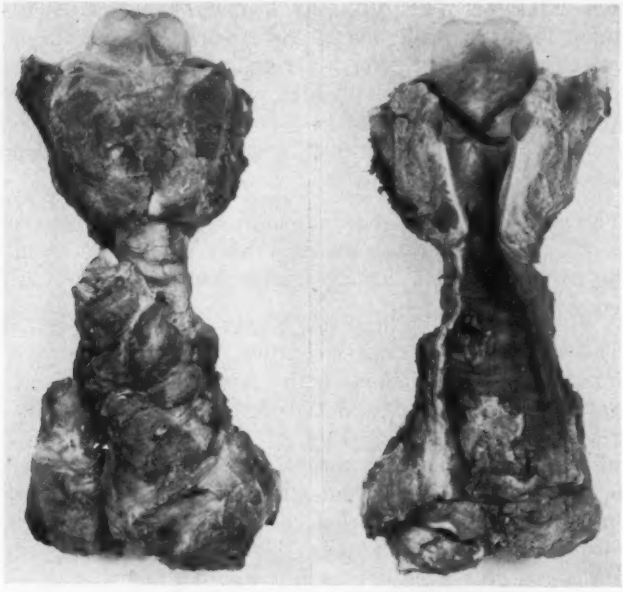

Fig. 6. (Case 14, Table III). Squamous cell carcinoma of the trachea. The collar-button character of the tumor is shown, the small intratracheal mass giving little evidence of the extratracheal extent of the tumor.

ports of series of cases, adenocarcinoma appears to be the most frequent malignant tumor. Only one of these has been encountered in our series. While the life expectancy of this group generally has been relatively poor, due to early invasion of adjacent vital structures and to metastases, occasional patients whose tumor is detected early will respond to local treatment and may be considered eligible for tracheal resection by some of the newer techniques. The following case report is of interest because of the duration of life after establishment of the diagnosis:

C. G. (Case 15, Table III), 52-year-old white male, entered St. Luke's Hospital for the first time July 2, 1943, complaining of an incessant, uncontrollable, nonproductive cough of one year's duration, an unexplained fever of six weeks' duration, and some weight loss. Complete blood counts, urinalysis and Kahn test were normal. A bronchoscopic examination was made July 3, 1943, which revealed a lobulated, somewhat pedunculated mass attached to the anterior tracheal wall, 2 cm. above the bifurcation and descending to the right main bronchus. Biopsy showed the tumor to be a squamous cell carcinoma of the trachea, and resection and electrocoagulation of all visible tissue were done. On the second admission, Feb. 8, 1945, bronchoscopy showed slight roughening of the trachea but no evidence of tumor tissue. On Oct. 23, 1946, a soft, friable tumor was again present on the anterior wall of the trachea and the biopsy was positive. The area of involvement was again extensively fulgurated after forceps removal of all pedunculated tissue. One month later reinspection showed the trachea to be smooth and the airway normal, but on March 15, 1947, a 1 cm. area on the anterior tracheal wall showed evidence of recurrence; this was fulgurated. By Dec. 10, 1947, partial obstruction of the trachea developed and this was reduced by bronchoscopic electrocoagulation; again on Jan. 23, 1948, the anterior wall was coagulated 2 cm. above the bifurcation. Respiratory difficulty occurred three and one-half months later and on May 12, 1948, the tumor was found to occlude one-half of the lumen of the trachea with compression of the right main bronchus. The airway was cleared by repeated bronchoscopic procedures. On May 28, 1949, one year later, bronchoscopy was done because of severe dyspnea. The patient was given nitrogen mustard intravenously, 6 mgm., four times in eight days, on this admission; repeated bronchoscopic procedures with removal of large amounts of tumor tissue were done to maintain the airway. Electrocoagulation and cup forceps were used to open the left main bronchus although the right side was still occluded. By June 22, 1949, a good view of the coryna and both main bronchi was obtained after removal of tissue from the anterior tracheal wall; eight 1.5 mc. radon seeds were injected into the tumor site bronchoscopically. Acute respiratory obstruction recurred frequently which required emergency aspiration and removal of tissue. Tracheotomy was considered, but because of the bilateral extent into the bronchi was not thought feasible. Guanazola 500 mgm daily and ACTH 175 mgm. were both given in July, 1949, preceded by a series of external X-ray treatments, three ports, a total of 3,185 for a calculated tumor dose of 4,190 r. On Nov. 19, 1949, a paralysis of the left vocal cord developed and it was found that the tumor extended up the trachea more than had been noted previously. The coryna was broad and eroded by the tumor. On Dec. 31, 1949, the tumor had advanced to a point 23 cm. from the upper teeth. Nine 1.5 mc. radon seeds were inserted into the tumor after resection of tissue with the bronchoscopic resectascope. Tissue removed from the right vocal cord on Dec. 28, 1949, showed squamous cell carcinoma of the larynx, apparently a separate carcinoma from that in the tracheobronchial tree. Recently metastatic glands in the right supraclavicular area have caused a partial paralysis of the right recurrent laryngeal nerve. At present there appears to be a temporary arrest of the growth although severe obstruction due to tracheal destruction is present.

Cylindroma of the trachea is reported frequently in the literature.[5,19,27,33,36] No primary cylindroma of the trachea has been encountered in this series, although one patient previ-

ously reported[48] (Case 17, Table III) died of obstruction of the trachea by a cylindroma of the right bronchus that advanced upward into the trachea. This patient had, in addition, multiple metastases to both lungs, and had been under observation for seven years; the airway had been repeat-

TABLE 3.

No.	Name and Sex	Age at Onset	Age at Admission	Symptoms and Laboratory	X-ray	Endoscopy	Therapy	Result	Diagnosis
11.	R.B. male	45 yrs.	45 yrs.	Dyspnea, hoarseness, weight loss, cough and hemoptysis	Negative chest film	Mass occluding trachea from subglottic space to 2 cm. above carina. Bloody positive.	X-ray. Attempted surgery. Tracheotomy.	Died 18 mos.	Squamous cell carcinoma of the trachea
12.	H.F. male	59 yrs.	59 yrs.	Dyspnea, cough and hemoptysis.	Chest X-ray negative	Mass in distal half of trachea partially occluding lumen	X-ray therapy	Died 7 mos.	Squamous cell carcinoma of the trachea
13.	A.F. male	40 yrs.	40 yrs.	Cough, hemoptysis, fever	Chest, X-ray negative.	Tumor subglottically on tracheal wall	X-ray therapy	Died 6 mos.	Squamous cell carcinoma of the trachea
14.	R.M. female	45 yrs.	45 yrs.	Cough, hemoptysis, dyspnea, chest pain.	Density, right lower lobe	Fibrous, irregular 2 cm. from upper gum.	Tracheotomy. X-ray therapy	Died 9 mos.	Bronchus cell carcinoma of the trachea
15.	G.D. male	59 yrs.	59 yrs.	Intermittent cough; no hemoptysis	Chest film negative.	Friable, granular tumor on tracheal wall 2 cm. proximal to carina	Endoscopic resection. X-ray therapy; Indon., Arsenic, Antimony, etc.	Premier free 5 years; normal progression of disease.	Squamous cell carcinoma of the trachea
16.	G.F. male	48 yrs.	48 yrs.	Cough, dyspnea, hemoptysis	Mediastinal mass in right hilus	Mass on right lateral wall above carina	X-ray therapy	Died 10 mos.	Adeno-carcinoma of trachea
17.a	L.K. female	47 yrs.	50 yrs.	Cough, dyspnea, hemoptysis	Atelectasis right upper lobe	Mass in trachea and right bronchus	Endoscopic removal X-ray therapy.	Died 56 yrs.	Cylindroma of the trachea, right bronchus.
17.b	L.K. female	47 yrs.	5 yrs.	Asthmatic wheezing, dyspnea	Chest negative. Lateral X-ray of trachea shows mass on anterior tracheal wall.	Firm, round mass on anterior tracheal wall 4 cm. below larynx.	Surgical removal of tracheal; plastic reconstruction	Living and well, 6 yrs.	Squamous of the trachea
18.	J.C. female	5 yrs.	6 yrs.	Rhonchi. Acute dyspnea	Bilateral emphysema.	Friable mass in right main stem and both bronchi	X-ray therapy (Operation not done because of severe leukopenia)	Died 6 wks.	Squamous of the trachea

* Previously reported [48]
** Previously reported [2]

edly re-established by bronchoscopic removal of obstructing tissue. Sarcoma and fibrosarcoma of the trachea are relatively rare,[1,41,50] and review of one case in this series originally thought to be a fibrosarcoma has led to its reclassification as a myosarcoma.[22]

Malignant tumors of adjacent structures which have invaded the trachea are included in this resumé of cases of tracheal tumors because of their similarity to primary tracheal tumors from the standpoint of history, X-ray and endoscopic findings. Ten carcinomas of adjacent structures were found invading the trachea to give primary symptoms and endoscopic findings of tracheal tumors. Eight of these were thyroid carcinomas, and two were esophageal carcinomas that had extensively invaded the trachea to cause respiratory obstruction. The following case reports are representative of this group:

J. A. (Case 22, Table IV), a 55-year-old white man, entered The Resarch and Educational Hospitals on July 10, 1945. He had been referred to the hospital because of dysphonia and stated that he had been hoarse for two and one-half months and had lost 15 pounds in weight. Mirror examination of the larynx revealed a bilateral recurrent laryngeal nerve paralysis, and inspection of the trachea showed a friable mass nearly occluding the trachea below the larynx. Tissue removed at this time showed the tumor to be a carcinoma of the thyroid. Because of the severe dyspnea a tracheotomy was done on Sept. 17, 1945. From Sept. 20, 1945, to Oct. 12, 1945, the patient received 4,700 Roentgens to the thyroid region through three portals. He progressed rapidly downhill and died less than five months after the onset of his symptoms.

M. D., (Case 28, Table IV), 54-year-old white woman, was admitted to St. Luke's Hospital on Sept. 22, 1949. She had been well until February, 1949, when she developed asthmatic breathing and, on careful questioning, stated that she had had some dysphagia and gagging. The dysphagia continued until September, 1949, but her principal difficulty was an increase in the noisy breathing and shortness of breath. This was treated as bronchial asthma with no success. At the time of admission to St. Luke's Hospital, Sept. 22, 1949, the patient was in constant respiratory distress and a bronchoscopic examination was made immediately in an effort to open the airway. A large tumor was found occluding the trachea and appeared to be attached to the right posterolateral wall of the trachea, 4 cm. distal to the larynx. A tracheoscope was passed, and the main portion of the tumor removed. Immediate relief from dyspnea resulted. It was believed that this was either a primary tracheal tumor or an erosion from the esophagus or thyroid. The biopsy showed the tumor to be a squamous cell carcinoma. Subsequent barium esophagrams and esophagoscopy revealed the primary lesion to be in the upper esophagus. Laboratory studies demonstrated a hypochromic anemia. Following the endoscopy the patient was given 1,170 r. to the right and

left lateral neck ports. The subsequent course was one of progression of the disease which required a gastrostomy for feeding purposes. The patient died approximately three months after the diagnosis was established.

TABLE 4.

No.	Name and Sex	Age at Onset	Age on Admission	Symptoms and Laboratory	X-ray	Endoscopy	Therapy	Result	Diagnosis
20.	P.B. male	67 yrs.	69 yrs.	Hoarseness, dyspnea, dysphagia	Tracheal and esophageal tumor, compression above level of clavicles.	Friable mass 3 cm. below larynx. Biopsy: Squamous cell carcinoma of thyroid	Attempted thyroidectomy, tracheotomy, Gastrostomy	Died 8 yrs.	Carcinoma of thyroid
21.	O.D. male	46 yrs.	55 yrs.	Hoarse; mass in neck; dysphagia; stridor	Anterior compression of cervical trachea.	Paralyzed right cord. Friable mass, 4cm. below larynx. Biopsy: Squamous cell carcinoma of thyroid	X-ray therapy. Gastrostomy	Died 4 mos.	Carcinoma of thyroid
22.	J.d. male	55 yrs.	55 yrs.	Hoarseness; weight loss of 15 pounds.	Mass compressing and invading cervical trachea.	Bilateral vocal cord palsy involving paratracheal tissues at level of thyroid. Biopsy: Carcinoma of thyroid	Tracheotomy X-ray therapy	Died 5 mos.	Carcinoma of thyroid
23.	M.T. female	49 yrs.	69 yrs.	"Tumor in thyroid", weight loss, dyspnea	Compression and distortion of trachea to left with invasion of tracheal wall.	Friable mass in trachea below arytenoid cartilage. Biopsy: Carcinoma of thyroid	Thyroidectomy; Tracheotomy; Radium implantation; X-ray therapy	Died 2½ yrs. after diagnosis of carcinoma of thyroid; 1 yr. after tracheal invasion	Carcinoma of thyroid
24.	A.B. female	73 yrs.	75 yrs.	Cough, sneeze, hemoptysis, weight loss	Deviation of trachea at 4th level of clavicles.	Mass on right side of trachea, region of 4th rib. Biopsy: Carcinoma of thyroid	Tracheotomy; X-ray therapy	Died 3 yrs.	Carcinoma of thyroid
25.	S.L. female	52 yrs.	53 yrs.	Progressive dyspnea; no hemoptysis	Marked distortion and narrowing of trachea with silk-like lumen for 4 cm. left of midline	Mass in trachea below cords, with complete glottic occlusion; cell block: carcinoma of thyroid	Tracheotomy; X-ray therapy	Died 1 yr.	Carcinoma of thyroid
26.	K.B. female	49 yrs.	58 yrs.	Dyspnea; mass in neck.	Posterior and left lateral compression of cervical trachea.	Paralysis, rt. vocal cord; deviation of trachea to left. Papillary projection on rt. tracheal wall. Biopsy: Carcinoma of thyroid	Thyroidectomy; X-ray therapy; Radium implantation; Tracheotomy	Died 3 yrs.	Carcinoma of thyroid
27.	E.H. female	47 yrs.	51 yrs.	Hoarseness; mass in neck; dyspnea; cough; hemoptysis	Mass in neck; trachea at 4th level; mark fill	Paralysis, right cord. Friable bleeding mass on right wall occluding trachea	Tracheotomy; X-ray therapy; Thyroidectomy	Died 4 yrs.	Carcinoma of thyroid
28.	E.D. female	54 yrs.	54 yrs.	Dyspnea; orthopnea; wheezing; "asthmatic attacks"; dysphagia	Irregular filling defect at thyroid & swelling of post-tracheal wall.	Friable mass in upper trachea. Esophagoscopy: Negative. Cell block: Carcinoma of esophagus; Biopsy: Carcinoma of esophagus and trachea.	X-ray therapy; Gastrostomy	Died 7 mos.	Carcinoma of Cervical Esophagus

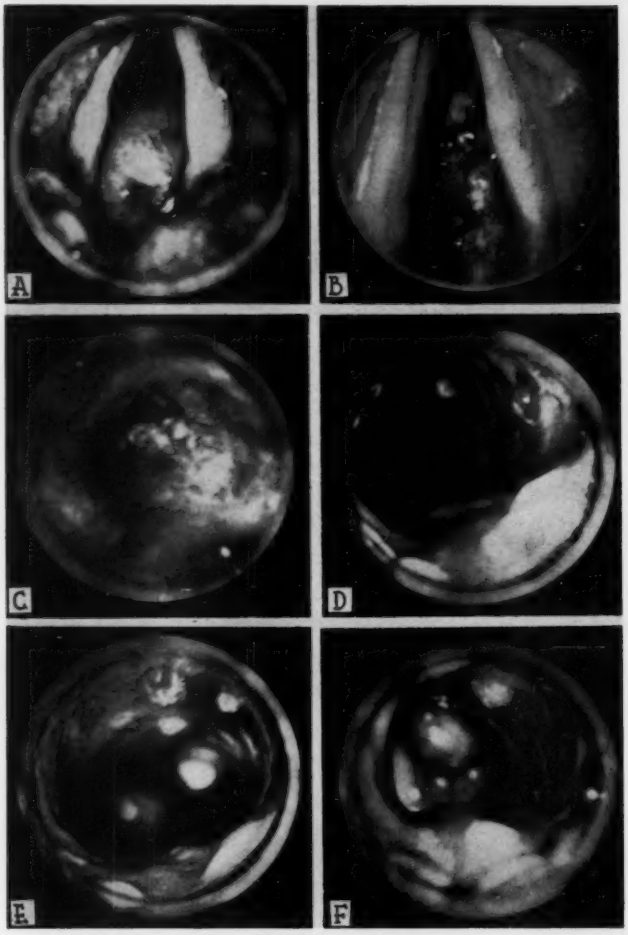

Fig. 7. Endoscopic photographs of various tracheal tumors. (A) (Case 7, Table II). Pedunculated fibroma attached to the posterior wall of the trachea at the level of the second tracheal ring. (B) (Case 11, Table III). Carcinoma of the cervical trachea extending upward into the subglottic space. (C) (Case 16, Table III). Adenocarcinoma of the distal trachea. (D) (E) (F) Carcinoma of the coryna with seeding of carcinoma along the walls of the trachea. (D) Level of the first ring; (E) midtrachea; (F) 1 cm. above coryna.

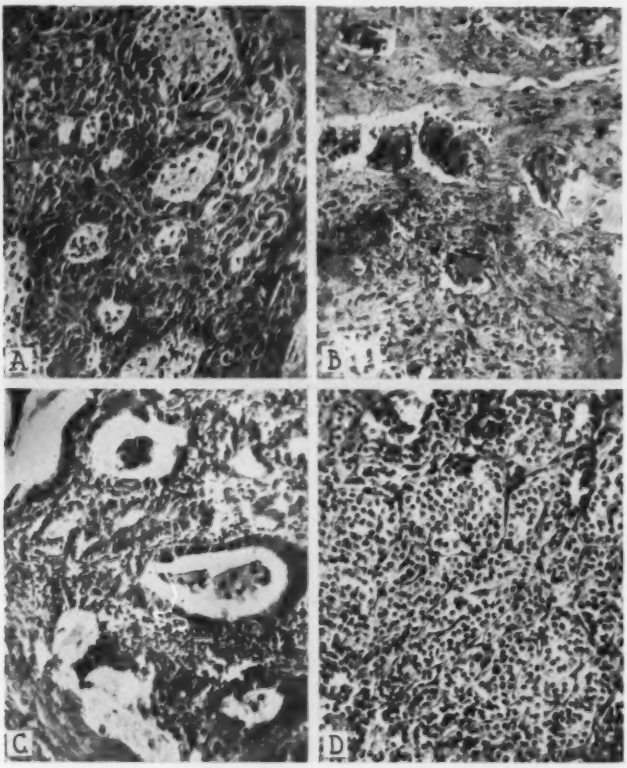

Fig. 8. Photomicrographs of four representative tracheal tumors. (A) (Case 11, Table III). Preliminary squamous cell carcinoma of the trachea. (B) (Case 4, Table I). Torula of the trachea. (C) (Case 16, Table III). Adenocarcinoma of the trachea. (D) (Case 10, Table II). Adenoma of the trachea.

DISCUSSION.

In most cases in this series the first symptom noted was a hacking, dry, constantly irritating cough that could not be relieved with cough sedatives or expectorants. The cough was frequently associated with hemoptysis which varied from slight blood streaking to gross hemorrhage, most pronounced in the malignancies. Stridor was another constant symptom

which at first was quiet and positional and later became a loud, asthmatic expiratory wheezing which was bilateral and so clearly simulated asthma that most of the patients had had thorough and repeated allergy studies and treatment for asthma. Dyspnea and orthopnea were present in the late cases, and hoarseness occurred in the malignancies when vocal cord paralysis developed because of outward extension or mediastinal involvement. Dysphagia was occasionally noted.

The history of the symptoms noted above as well as the physical findings were exceedingly important in establishing the diagnosis in the patients in this series. The X-ray studies included inspiration and expiration chest films, lateral X-rays of the neck and trachea, planograms in the anteroposterior and lateral planes, and bronchographic studies. The final diagnosis was made by the bronchoscopic examination (see Fig. 7) and the removal of tissue for biopsy (see Fig. 8).

The first problem in treatment was usually the establishment of the airway. This frequently was an emergency procedure consisting of coring the tumor, removal of obstructive tissue by forceps or snare, and occasionally a tracheotomy, the tube being inserted below the tumor or through or beyond it by the use of a long tracheotomy tube. Endoscopic electroresection and coagulation were important endoscopic procedures in keeping the airway free of tissue.[23] Radon implantation and external irradiation were adjuncts in the treatment of the malignancies. Tracheal resection was accomplished in one case of myosarcoma of the trachea to give a five-year cure[22] and will undoubtedly assume a more important rôle in future cases if early diagnosis can be accomplished. The experimental work on intrathoracic tracheal resection gives promise of a new procedure available for selected cases of tracheal tumors.[9]

SUMMARY.

1. The clinical data of 28 cases of tracheal tumors are presented. Eighteen of the tumors were primary in the trachea, 10 invaded the trachea from adjacent structures to give signs, symptoms and endoscopic findings of

primary tracheal tumors. Five of the tumors were inflammatory, and 23 neoplastic, of which five were benign and 18 malignant.

2. The symptomatology was similar in most cases. The earliest symptom was generally a dry, hacking cough, followed by wheezing which was frequently so clearly expiratory and bilateral in character that most patients had had extensive surveys and treatment for asthma. Hemoptysis was a constant finding in the patients with malignant tracheal tumors, only occasionally in patients with benign tumors. As the lesions progressed, dyspnea and orthopnea increased. Hoarseness was present in the later stages of the malignant tumors because of extension to involve the recurrent laryngeal nerves. Dysphagia was a rare accompanying symptom.

3. Diagnostic studies included posteroanterior and lateral film studies of the neck and chest, fluoroscopic examinations and planograms. Single chest X-rays were usually negative in even advanced cases. The final diagnosis was established by tracheoscopic examination and the histologic evaluation of tissue removed.

4. The primary step in treatment of most cases was to establish the airway. This was done by forceps, tracheotomy, snare or, in severe emergencies, by coring directly through the tumor with the bronchoscope. Subsequent endoscopic treatment consisted of electroresection and coagulation, radon seed implantation and repeated forceps removal. External irradiation was employed in the malignant tumors. Cervical tracheal resection was successfully employed in one case, but while resection of the thoracic trachea may be considered in the future, this procedure could not be employed in any case in this series.

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EPIDERMOID CARCINOMA OF THE LARYNX OCCURRING IN TWO CHILDREN WITH PAPILLOMA OF THE LARYNX.

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INTRODUCTION.

Papilloma of the larynx, the most common of all benign tumors in this organ, may be classified as either of two types on the basis of clinical observations and the histologic pattern of the lesion: *a.* a focal or diffuse hyperplastic thickening of epithelium with prominent hyperkeratosis, usually presenting a fairly regular and evenly contoured surface; *b.* a focal or diffuse, fungating hyperplastic thickening of epithelium, usually without a significant amount of keratosis, and presenting an irregularly contoured, rugose surface. The former, often called "hyperkeratotic papilloma," is usually encountered in adults and occasionally precedes the development of carcinoma of the larynx, particularly in men beyond the fourth decade of life. The second type, frequently called "juvenile papilloma," is usually found in infants and children, and seldom precedes the development of a malignant tumor of the larynx.

Owing to the apparent rarity of carcinoma developing at or in the site of papilloma of the larynx in a child, the following discussion of two cases seems to be deserving of consideration:

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CLINICAL OBSERVATIONS.

Case 1: D. M., a white boy, 12 years old, was admitted to the St. Louis Children's Hospital for the first time, at the age of 16 months, with a history of hoarseness and diminution in voice beginning when the infant was 10 months old. During the six months prior to the first admission these symptoms had progressed and the child developed difficulty with respiration. Examination revealed a profuse growth of papilloma in the larynx. The tumor was removed through a Jackson laryngoscope, and the patient was discharged a few days later. Two months thereafter the child (age, 18 months) was admitted for the second time, and recurrent papilloma was removed by the Lynch suspension method. From this period, until the child was 39 months old, he was admitted to the hospital 11 times more for removal of rapidly recurring papilloma, the admissions varying between one and six months apart. During some of the admissions (between the ages of 30 and 35 months), in addition to surgical removals of tumor, the patient was treated by X-radiation to the larynx according to the following schedule:

Date	Age	Port	Kv.	Filter	Dist.	M.A.	Time	Units
6/29	30 mo.	50 sq. cm.	200	1.0 cu. lal.	50 cm.	15	18 min.	570 R.
8/ 7	32 mo.	65 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9 min.	675 R.
8/ 8	32 mo.	65 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9 min.	675 R.
10/19	34 mo.	65 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9 min.	675 R.
11/12	35 mo.	65 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9 min.	675 R.

Total X-radiation = 3270 Roentgen units.

During the series of admissions shown in the above schedule, tracheotomy was performed (age, 34 months) and the cannula was worn continuously for the remaining nine years of the child's life. The patient was brought to the hospital for his fourteenth admission when he was seven years old, and recurrent papilloma was removed from the larynx and trachea.

The boy was not under physician's care again until one of the present authors (T. E. W.) examined him for the first time, during the child's fifteenth admission (age, 11 years). At this time the tracheotomy wound was infected, and the patient had difficulty with swallowing and regurgitated fluids through the tracheotomy. The larynx was filled with papilloma, and tracheoscopy revealed a tracheoesophageal fistula. Biopsy of the tumor revealed interesting histologic findings discussed below. During this admission, and the sixteenth and seventeenth which followed four and nine months later, respectively, various methods of therapy were tried. Topical and parenteral estrogenic medication caused no apparent change in the tumor. The infection was treated with penicillin and sulfonamides. During the fifteenth admission gastrostomy was performed, and closure of the tracheoesophageal fistula was attempted by a plastic surgeon by turning a flap of skin between the trachea and esophagus. This procedure was accomplished from one side, and, owing to an unsatisfactory result, another skin-flap was brought in from the opposite side in a second repair. The patient was discharged shortly thereafter with slight improvement in his general condition.

The eighteenth and final admission, about one month later (age, 12 years), was occasioned by recurrent severe vomiting, loss of weight, and

generally poorer condition of the boy. Technically, the second plastic repair was successful, but tumor had involved the area in and about the operative wound. This region was infected, also, and there were draining sinuses in the neck. Following blood transfusions and proper diet, there was temporary improvement in the patient's general condition. Sanguineous exudate and blood began to ooze from the sinuses, and, despite supportive therapy, the child died from a massive hemorrhage on the twenty-second hospital day.

A large series of biopsies, taken during the 18 hospital admissions, revealed interesting histologic findings which are presented below with a brief summary of the autopsy observations.

Case 2: V. S., a white girl, was admitted to the St. Louis Children's Hospital for the first time when she was three years old. The parents stated that the child suffered "frequent attacks of croup" since infancy. Six months prior to admission she lost her voice and was treated by a physician who "removed growths from the larynx"; this procedure was repeated about three months later. Upon admission to the hospital the larynx was full of papilloma of the "juvenile type," the airway was markedly restricted, and tracheotomy was performed to give the girl relief. A profuse growth of papilloma was removed by direct laryngoscopy at this time and at frequent intervals during the succeeding several weeks. The tumor recurred so rapidly that therapy by X-radiation to the larynx was advised and administered according to the following schedule:

Date	Age	Port	Kv.	Filter	Dist.	M.A.	Time	Units
11/6	3 yrs.	50 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9.2 min.	550 R.
11/7	3 yrs.	50 sq. cm.	200	0.5 cu. lal.	50 cm.	15	9.2 min.	550 R.

Total X-radiation = 1100 Roentgen units.

So far as is known the patient was not under a physician's care again until one of the present authors (T. E. W.) examined her eight years later (age, 11 years). The larynx was filled with papilloma, and the tracheotomy tube, which had been worn continuously since its insertion, provided her only airway. The papilloma was removed, but it was impossible to rid the patient of the tracheotomy. The girl was not seen again in this institution until she was admitted to the McMillan Hospital two years later (age, 13 years). The patient related that she suffered pain in the throat, associated with swelling and redness of the neck, for the preceding three days. Examination revealed a large mass of papilloma filling the hypopharynx and obstructing the glottic chink. An airway was being provided by a No. 1 tracheotomy tube which had been worn continuously. Redness and swelling of the neck extended from the level of the thyroid cartilage to the clavicle, and the neck was markedly tender to palpation. Therapy with penicillin resulted in regression of the inflammation. X-ray plates of the laryngeal region were made and the radiologist reported that "the thyroid and cricoid cartilages are not seen and the soft tissue lines are obliterated." A No. 3 tracheotomy tube was inserted on the fourth hospital day to increase the airway, and on the eighth day a No. 5 tube was inserted. Laryngoscopy was performed on the ninth hospital day, and repeated on the fourteenth, twenty-first, and twenty-fifth days, to attempt excision of the papilloma. After removal of tumor from the region of the true cords, the usual anatomic landmarks were obviously distorted and the arytenoids moved poorly, if at all. The

tumor extended subglotically to the region of the tracheotomy. On the twenty-seventh hospital day a granulating fistulous tract developed just above and to the right of the tracheotomy tube. Purulent exudate drained from the tract for several days. Microscopic examination of a biopsy removed from the wall of the fistula revealed granulation tissue with subacute inflammation. The patient was discharged for a short interim, and was readmitted several days later as a candidate for laryngofissure. This procedure was advocated with the hope that the papilloma might be removed completely, and that, possibly, a skin graft might be applied to the larynx in order to construct a useful airway. On the ninth hospital day a midline incision was made through the external thyroid perichondrium. The thin and necrotic anterior halves of the thyroid cartilages were removed, and the fistulous tract (described above) was explored and found to extend through the cricoid-thyroid membrane. The entire subglottic area downward to the tracheotomy was filled with a papillomatous mass, which appeared to be infiltrating deeper tissues. Much of the tumor was removed, and the wound was packed with penicillin-gauze and left unsutured. Specimens submitted for histologic examination revealed irregular groups of atypical squamous cells deep within the lamina propria and adjacent to the remnants of cartilage. Owing to the observations made at opera tion and the studied opinions of several pathologists (discussed below), it was concluded that laryngectomy should be performed. Consequently, the larynx was resected 10 days later, and, except for the development of a small bit of tumor which was removed from the tracheotomy stome, the tumor has not recurred and the patient has been free from symptoms for almost three years.

COMPARATIVE PATHOLOGIC STUDIES AND INTERPRETATIONS.

Benign Papilloma. During the first 12 hospitalizations of D. M. (Case 1), which occurred between the ages of 16 months and three years, portions of the tumor in the larynx were submitted for histologic examination on five occasions. The third and fourth of this series of specimens were removed during the X-radiation therapy described in the schedule shown previously, and the fifth was removed approximately one month after the last treatment by X-radiation. The gross properties of the tumor in each of the five specimens, as observed by clinicians and the pathologist, were essentially identical with the others, and were characteristic of the usual benign papilloma of the larynx encountered in children. The histologic structures, likewise, were characteristic of this tumor and were essentially identical in all five instances, with the possible exception of slight variations noted in the specimens taken during and after the period of X-radiation. These variations are of indeterminable significance; they were regarded as unimportant.

During the first admission of V. S. (Case 2), when the girl was three years old, portions of tumor were examined histologically on one occasion, prior to X-radiation treatment. Sections of tumor removed during or after radiation therapy are not available. Initially, the tumor was grossly and microscopically characteristic of benign papilloma, and the laryngologist who first cared for the patient in the St. Louis Children's Hospital reported that there was no apparent change in the tumor following therapy with the relatively small amount of X-ray administered.

In general, microscopic examination of portions of tumor from both patients, at the times described above, revealed enormous "piling up" of proliferating squamous epithelial cells in a complex dendritic network, enclosing areas of well vascularized areolar connective tissue. The basement membrane was intact and regular, clearly delineating the proliferating epithelium from the supporting connective tissue, both subjacent to and within the mass of epithelial tissue. Slight variations noted in the tissue removed from D. M. (Case 1),

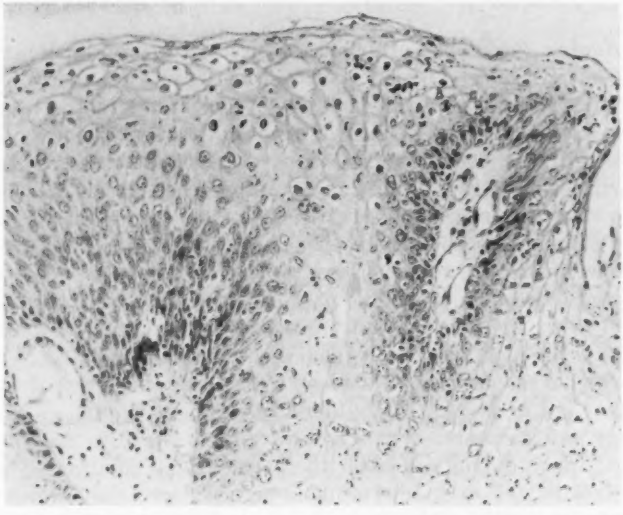

Fig. 1. Benign papilloma. Case 1, D. M. (biopsy at age, 35 months).

one month after X-radiation, consisted only of a few more mitotic figures in scattered regions, and, occasionally, small areas of squamous cells wherein the cytoplasm was vacuolated or the nuclei varied in size and staining reaction. Similar features were noted to somewhat lesser extent in tumor removed from V. S. (Case 2) prior to X-radiation. Figures 1 and 2, prepared from randomly selected areas of tumor from D. M. and V. S., respectively, illustrate the typical histologic structure of benign papilloma of the larynx. The tumors were closely similar in structure, and, in most areas, were essentially identical.

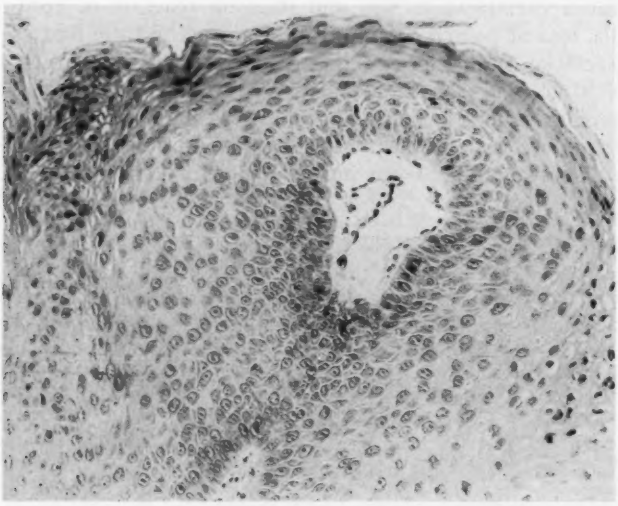

Fig. 2. Benign papilloma. Case 2, V. S. (biopsy at age, 36 months).

Phase of Transformation. For a period of more than eight years following the above studies, no histologic preparations of the tumor from D. M. (Case 1) are available for evaluation.* When the patient was almost 12 years old, he was

*Reference to the clinical history indicates that the patient returned to the hospital for the fourteenth admission when seven years of age. According to the record papilloma was removed from the larynx at this time, but the tissue was not studied histologically.

admitted to the hospital for the fifteenth time, and was first seen by one of the present authors (T. E. W.). At this time the larynx was filled with papilloma of characteristic gross appearance, and there was suppurative inflammation about the tracheotomy tube, which had been worn continuously since its insertion at the age of three years. Much of the tumor was removed, and histologic study of several fragments revealed interesting and significant differences in anatomic structure. Although some of the sections, especially those prepared from the more superficial regions, were closely similar to those studied more than eight years before (see Fig. 1), sections prepared from deeper portions of tumor demonstrated variations in size and staining reaction of epithelial cells, loss of polarity, and a few abnormal mitotic figures. In association with these changes, the basement membrane was indistinct and sometimes disrupted in continuity. Several irregular groups of epithelial cells were found within the supporting stroma and deep within the lamina propria (see Fig. 3). These findings were interpreted as evidence that malig-

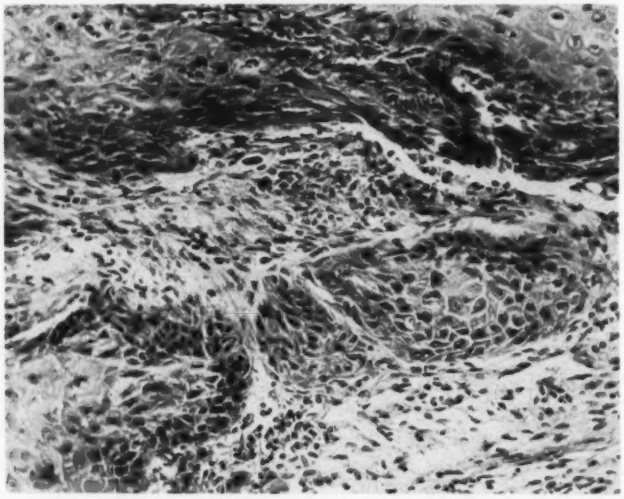

Fig. 3. Malignant transformation. Case 1, D. M. (biopsy at age, 11 years).

nant transformation had occurred, at least in some regions, in this previously benign tumor. It is interesting to note that two consulting pathologists reviewed the sections and remarked that the tissue bore a close resemblance to tumors not infrequently encountered in the bladder and regarded by some observers as "histologically malignant papilloma."

In the instance of V. S. (Case 2) there are circumstances somewhat similar to those with D. M. Reference to the clinical record summarized above reveals that she had benign papilloma removed several times before she was three years old, received X-radiation therapy to the larynx, and wore a tracheotomy tube continuously for about eight years. At the age of 11 years she was examined for the first time by one of the authors (T. E. W.); large amounts of papilloma were removed,* and the tracheotomy tube was left in place. The patient was not studied again until two years later (age, 13 years); examination revealed a large mass of tumor filling the larynx and involving the tracheotomy stoma. Similarly to Case 1, the more superficial portions were essentially identical in gross and microscopic structure with the benign papilloma observed two years and 10 years previously (see Fig. 2); however, when deeper portions of the tumor were examined, irregular large groups and small clumps of squamous cells were found within the stroma and deep in the lamina propria, outside the boundary of the basement membrane of the overlying proliferative epithelium (see Fig. 4). In several areas the basement membrane was indistinct and disrupted. A few large, sometimes vacuolated epithelial cells with bizarre staining reactions were noted, but, in general, cytologic variations were not as prominent as those in Case 1 (see Fig. 3). The authors, and four consulting pathologists, were in essential agreement that histologic findings, such as those illustrated in Fig. 4, provided evidence that malignant transformation had occurred in this previously benign papilloma.

Epidermoid Carcinoma. During the eighteenth hospital admission of D. M. (Case 1), approximately nine months after

*The tissues examined at this time were essentially identical with those studied several years previously.

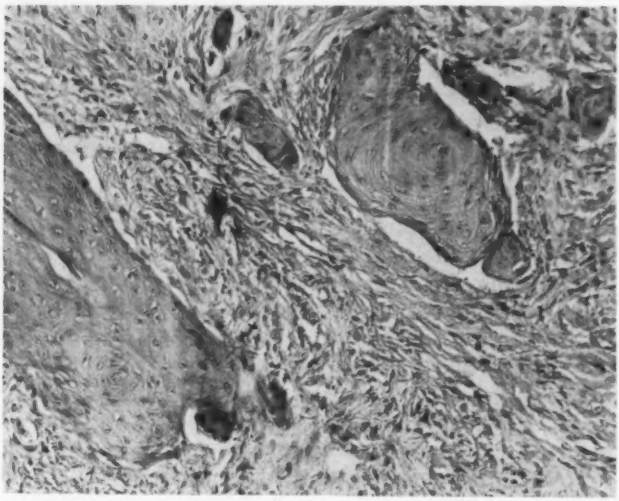

Fig. 4. Malignant transformation. Case 2, V. S. (biopsy at age, 13 years).

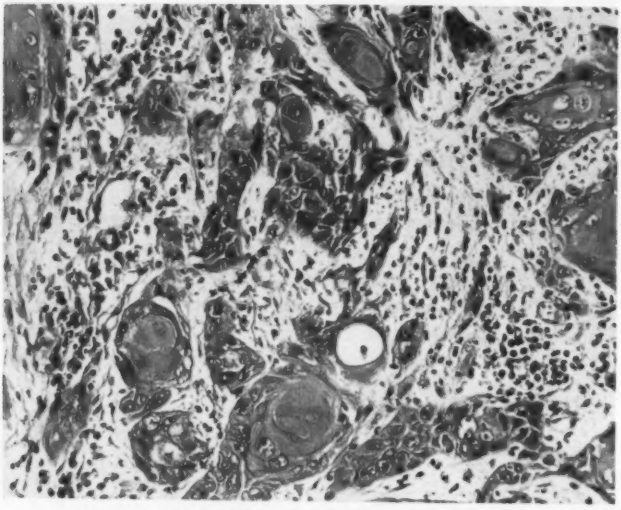

Fig. 5. Epidermoid carcinoma. Case 1, D. M. (biopsy at age, 12 years).

the diagnosis of "histologically malignant papilloma" was made and the larynx removed, portions of firm, gray-white tissue were removed from draining sinuses of the neck and examined histologically. The tissue was composed of numerous sheets and cords of large, irregularly shaped, neoplastic epithelial cells between which intercellular bridges were demonstrable. Groups of cells frequently showed lightly stained basophilic cytoplasms and large variable nuclei with hyperchromatic nucleoli. Occasionally, abnormal mitotic figures were noted, but the conspicuous feature of the tumor was the large number of epithelial pearls. The tumor was regarded as a well differentiated carcinoma (see Fig. 5). Tissues removed *postmortem** confirmed this diagnosis. Carcinoma involved the upper portion of the trachea, and extended directly into the thyroid gland and other soft tissues of the neck, forming tumor-lined tracts between the lumen of the trachea and the cutaneous surface. Likewise, tumor extended directly into the middle of the esophagus; the lumen of this organ, also, communicated with the cutaneous surface by tumor-lined tracts. No metastases of carcinoma were noted in any organ. Sinuses described above contained bloody purulent material, and, as evidence of massive hemorrhage, large amounts of blood were present in the trachea and bronchi, the esophagus and stomach, and in the oral cavity. Other pathologic findings were secondary or incidental, and not pertinent to this discussion.

Owing to the interpretation that malignant transformation had occurred in the papilloma in V. S. (Case 2), it was concluded that the girl's larynx should be removed. Laryngectomy was accomplished successfully, and, with the exception of a small bit of papilloma excised from the tracheotomy stoma, there was no evidence grossly that the tumor traversed the boundaries of the larynx. Thorough histologic studies of the specimen revealed evidence of invasion in some areas. For example, irregular large groups and small clumps of atypical squamous cells were observed in the connective tissue immediately adjacent to the thyroid cartilage but not within

*Autopsy No. 11259, performed in the Department of Pathology, Washington University School of Medicine.

this structure; furthermore, similar neoplastic cells were noted in the connective tissue between the first and second cartilaginous rings of the trachea (see Fig. 6, where the supe-

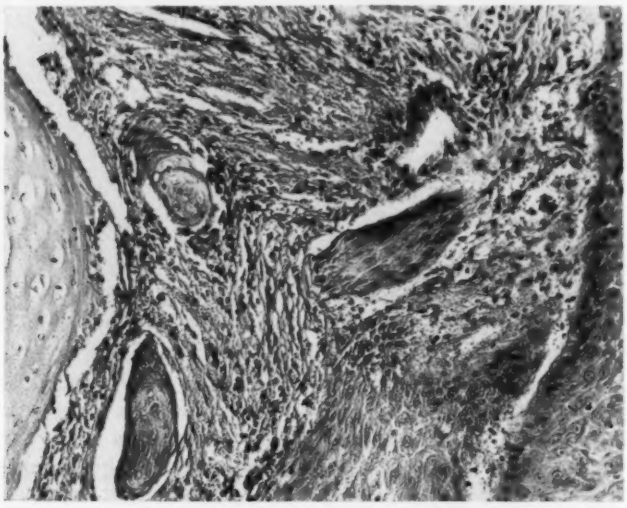

Fig. 6. Epidermoid carcinoma. Case 2. V. S. (laryngectomy specimen at age, 13 years).

rior portion of the second ring is shown at the left of the photomicrograph). Careful study of the second interspace (inferior to the second ring), which was the lower extent of the excised tissue, revealed no involvement of this region by tumor. Although the cytologic features of the tumor were not as striking as they were in Case 1, the authors felt that a diagnosis of well differentiated epidermoid carcinoma was justified inasmuch as epithelial tumor cells were present in deep supportive structures, presenting a disorderly and unrestricted pattern of growth.

COMMENT.

Jackson and Jackson[1] emphasize that papilloma in a child's larynx is "always benign and usually self-limited." Although

laryngologists and pathologists agree generally with this thesis, the lesion is deserving of special consideration, nevertheless, because *a.* it is apt to cause serious obstruction to the passage of air, *b.* it sometimes regresses spontaneously, and yet *c.* it is prone to recur after removal, even after repeated removals in many instances. Perhaps a fourth reason should be added: despite the fact that papilloma of the larynx in a child is usually benign, there are rare instances in which a malignant tumor has developed within, or directly contiguous with, an area previously involved by papilloma of the "juvenile type." Papillomata in adults are occasionally the sites of development of carcinomas; many reports in the literature, as well as experiences in several clinics, affirm this. For example, Jackson and Jackson[2] reported that cancer of the larynx developed in 3 per cent of adults with papilloma studied in their clinic; in other series the incidence sometimes is slightly higher. In contrast, the present authors found only one paper reporting malignant transformation in papilloma of the larynx in a child. Unfortunately, the reference to this paper was lost, and subsequent searching failed to reveal the location of the paper; however, it is recalled that the patient was a child, about eight years old, with a relatively long history of recurrent papillomata of the larynx. Besides this case and the two described in this paper, only one other similar instance (a boy, 13 years old) has come to our attention.[3] So far as the authors are aware, this latter case has not been published.

Even a brief discourse on the pathogenesis of epidermoid carcinoma of the larynx in the two children described in this paper must be largely conjecture. In the first place, although some investigators postulate that the initial lesion (benign papilloma of the larynx in children) is a viral disease, the fact is that the causal and other factors responsible for this lesion are not known. Secondly, as a basis for further conjecture concerning cause and effect, certain features are common to the two cases reported herewith:

a. both children developed benign papilloma at relatively early ages;

b. both children suffered frequent and rapid recurrences of papilloma following skillful and apparently proper surgical removals; at no time was there any indication of spontaneous regression;

c. both children received X-radiation therapy to the larynx, relatively small in amount, at a time when the tumor was still histologically characteristic of benign papilloma;

d. owing to the extent of the disease both children were required to wear tracheotomy tubes for several years; in both instances, inadequate care in the long intervals between visits to the hospital must have a significant factor in the moderately severe inflammation which involved soft tissues of the neck and the tumor itself.

Thirdly, having harbored benign papilloma in the larynx for several years, both patients developed epidermoid carcinoma of the larynx; although both tumors were well differentiated, one showed a higher degree of anaplasia than the other.

The question of whether or not X-radiation played a rôle in the transition of the benign tumors into carcinoma is most difficult to evaluate, and our present knowledge is not sufficient to provide a conclusive answer. The X-radiation occurred several years prior to the development of the malignant tumor, and there are well recognized instances wherein carcinoma has developed long after an X-ray burn of the skin. In these cases, X-radiation was considerable in amount; in the two patients reported in this paper the dosage was relatively small. Three competent radiologists were consulted about this matter, and they stated rather dogmatically that on the basis of their experience the exposure to X-ray in these cases could have done no harm, especially the small amount given in Case 2. On the other hand it is interesting to note that two consulting pathologists who reviewed the slides from Case 1[4] raised this question independently of each other.

Another problem pertinent to the discussion is that regarding the rôle of the infection in each case. This complicating factor was present for a considerable time and was evident at the time when transition was noted in both tumors. Here again there is not sufficient factual knowledge to assess this factor adequately.

The causation of carcinoma is a complex and varied process. For example, Shope's papilloma virus is known to be the cause of a benign tumor occurring naturally in the skin of cotton-tail rabbits. Infectious papillomatosis may be transmitted serially in cotton-tail rabbits, but not all animals are susceptible and, in a large percentage of those in which lesions develop, spontaneous regression occurs. Malignant changes in the papillomata are unusual or rare. On the other hand, papillomata may develop in domestic rabbits, and, in a considerable number of these after some weeks or months, invasion of subjacent tissues and metastases to distant regions may occur; furthermore, the transformation to the malignant tumor may be brought about rapidly if a carcinogenic agent, such as tar, is applied to a virus-induced papilloma. Drawing on our knowledge concerning causation of certain malignant tumors in various organs, it is noteworthy that there probably is *not only one* causal agent of cancer, but that a *few* or *multiple* factors, previously present or coexistent in a given host, "set the stage" for the development of a malignant tumor. Owing to the lack of more specific knowledge, one is left with this somewhat unsatisfactory thesis concerning the development of carcinoma at, or within, the site of a benign tumor. From this one might speculate that the X-radiation, the infection, or a combination of both, perhaps in association with unrecognized factors (some of which may be inherent in specific strains or individuals), resulted in development of carcinoma at the site of previously benign papilloma of the larynx in the two children described in this paper.

SUMMARY.

1. Clinical and pathologic studies of a boy (age, 12 years) and a girl (age, 13 years) with epidermoid carcinoma of the larynx are presented and discussed.

2. Histologic studies of papillomata of the larynx in children should be performed thoroughly and carefully. In both these cases, at the time some pieces of tissue revealed malignant tumor, other portions were characteristic of the usual benign papilloma of the larynx. The distinctions could not be made grossly, but only after microscopic studies.

3. Whenever there is significant irregularity of cytologic structure or departure from the usual histologic pattern, the lesion should be regarded with suspicion.

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EPISTAXIS — CASE REPORT.*

Report of a Case of Ligation of the External Carotid and Anterior Ethmoidal Arteries, and Section of the Posterior Ethmoidal Artery.

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Although most episodes of epistaxis are easily controlled, a rare case may be encountered which proves intractable, requiring ligation of part or of all the blood supply to the affected naris. The case reported is that of a patient suffering from uncontrollable nosebleed, in which the entire blood supply to the affected naris required interruption.

REPORT OF THE CASE.

R. B., a 74-year-old white male with arteriosclerotic heart disease and positive Kahn, was admitted to the Veterans Administration Center, Biloxi, Miss., the morning of April 30, 1950, for treatment of severe nasal hemorrhage. He had been treated in this hospital for epistaxis from the right naris on two previous occasions, July, 1949, and March, 1950, when simple packing and one or two transfusions sufficed to control the bleeding. On neither occasion could any cause be ascertained aside from arteriosclerosis or latent syphilis.

The present episode of bleeding began at home April 28, 1950, when he suffered two mild nasal hemorrhages. These were repeated the following day. At 5:30 A. M., April 30, 1950, he developed severe epistaxis which his local physician could not control by packing. At 7:30 A. M., when he was admitted to the hospital, he was bleeding profusely from the right nostril and was in shock. Even the approximate origin of the bleeding could not be seen. Blood pressure was 120/80, blood count was RBC 3,200,000, hemoglobin 11 gm. and pulse 120. Both nares were quickly packed blood transfusion given, and morphine gr. one-quarter administered. Vitamins C and K, and penicillin, 500,000 units twice a day, were ordered. He bled repeatedly that day through anterior and posterior packings, so that two more transfusions were required to replace the blood loss. The following evening, May 1, 1950, because of continued severe bleeding, the right external carotid artery was ligated above the

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origin of the superior thyroid branch. This procedure had no effect upon the bleeding. Subsequent nasal examination, using suction to clear the naris, and direct nasopharyngoscopic investigation, showed the hemorrhage to be coming from the region of the right superior meatus, but no definite bleeding point could be seen. From May 1 to 17 he bled intermittently despite packing and frequent transfusions. On May 17, 1950, under intratracheal anesthesia, through a right medial periorbital incision, the periosteum was elevated from the orbital wall till the anterior ethmoidal vessels were encountered. These were doubly ligated and sectioned between ligatures. Further elevation of the periosteum posteriorly for about 1.5 cm. disclosed the posterior ethmoidal vessels. These were divided with a Freer's elevator; there was no bleeding from the sectioned ends. A loose gauze drain was inserted between the periosteum and orbital wall, and the periosteum was closed with catgut sutures above and below the drain. The skin incision was closed with cotton sutures. The following day the gauze drain and nasal packing were removed. The nasal hemorrhage had ceased, and there has been no recurrence since the operation.

The patient was given a total of 6,500 cc. of whole blood, vitamins B, C and K intramuscularly and orally, and adequate parenteral penicillin for its effect on the positive serology and for its preventive action against infection. Despite the antibiotic therapy, X-ray examination of the sinuses following surgery showed cloudiness of the right antrum attributable to the repeated packing. Two months later X-ray examination showed that the sinuses were clear.

DISCUSSION.

For practical purposes, one need only remember that the portion of the nasal interior below the middle turbinate is supplied by branches derived from the external carotid artery; the region above the middle turbinate by the anterior and posterior ethmoidal arteries which are branches of the ophthalmic artery, in turn a branch of the internal carotid.[1]

The clinical application of these facts is not so widely known as the anatomy. Many cases attest the effectiveness of ligature of the external carotid artery for refractory epistaxis;[2] but, where this procedure fails, even more modern textbooks[3,4] neglect to advise ligation of the ethmoidals. For example, both Jackson[5] and Boies[6] prefer ligation of the internal carotid, a suggestion which is invalid for two reasons: first, Dandy[7] demonstrated that serious cerebral damage may occur unless a favorable Matas[8] test be present, and preliminary partial ligation be performed; second, Weddell *et al.*[9] showed that ethmoidal artery bleeding cannot be checked by common or internal carotid ligation because of the competence of the circle of Willis with respect to the ophthalmic artery.

Management of cases such as this, which have also been reported by other authors,[10-12] should be guided by the principles (with certain additions) which Weddel *et al.*[9] evolved through trial and error in their own seven cases.

1. The patient is treated for shock due to blood loss.

2. Visualization following suction, and the effect of packing local areas in the nose, help to determine the source of bleding—whether above or below the middle turbinate. If manual compression of the common carotid fails to control the blooding, the ethmoidals are presumed to be implicated (anastomosis via circle of Willis).

3. If the bleeding be from below the middle turbinate, the external carotid artery should be ligated; if from above, both ethmoidals should be ligated primarily.

4. In either case, if bleeding continues following the primary ligation, the remaining blood supply to the affected naris should be interrupted.

5. Where the hemorrhage from one naris is so severe as to preclude determination of the source, the external carotid should be ligated first because its branches are most often involved.[2]

6. Where there is profuse hemorrhage from both nares, uncontrollable by any other means, one should adhere to the same schema even if it requires ligation of both external carotids and/or all the ethmoidals.

In the case reported, had it been possible to determine the source of bleeding prior to ligation of the external carotid, the procedure of choice would have been primary ligation of the ethmoidals.

SUMMARY.

1. A case of severe unilateral epistaxis is reported in which, ligation of the external carotid artery having

failed to stop the hemorrhage, interruption of the ethmoidal arteries proved successful.

2. A logical procedure for determining and occluding the implicated arterial source is re-emphasized.

3. Where the source of bleeding is unknown, it may be necessary to interrupt the entire arterial supply to the affected naris.

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PLASTIC AND RECONSTRUCTIVE SURGERY.

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The literature of the past year deals almost entirely in civilian problems, with but few articles concerning wartime experiences.

NOSE.

The surgical repair of nasal deformities is summarized by Young.[1] Skin losses over the upper half of the nose are replaced with suitable free grafts, and pedicle flaps are used for covering the nasal tip and alar rims. Rhinophyma is a hypertrophic form of acne rosacea with an overgrowth of the sebaceous glands. The nose is cut down to normal contour and healing takes place from islands of epithelium that are left behind, or from the margins. Saddle nose is due to syphilis, trauma or too extensive a submucous resection. It is often necessary to reduce all dimensions of a humped or long nose. Retraction of the lower half of the nose may be corrected by moving the soft tissues forward and then inserting a cartilage graft to maintain this advancement. Distortions of nasal bones and cartilages by trauma and congenital deformities require repositioning of the framework and occasional cartilage transplants. Loss of lining of the nose may occur due to syphilis or to a burn, and repair with a skin graft is necessary. Partial or complete losses of the nose are best repaired with a forehead flap.

Nostril Border—A good nostril border, according to Brown and McDowell,[2] can be made from a composite ear graft (see Fig. 1). This graft contains skin and cartilage (see Fig. 2).

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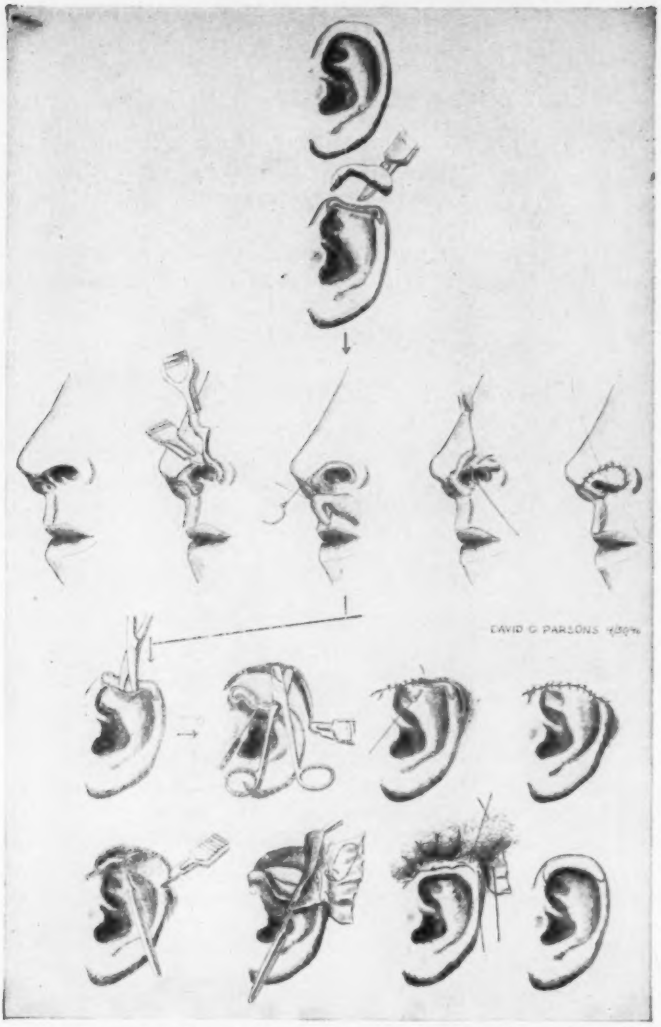

Fig. 1. Reconstruction of ala, angle and columella with a single composite free graft in one single operation. Secondary freeing of the ear from the scalp with a split graft, in this instance. The patient is also shown in Fig. 2. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

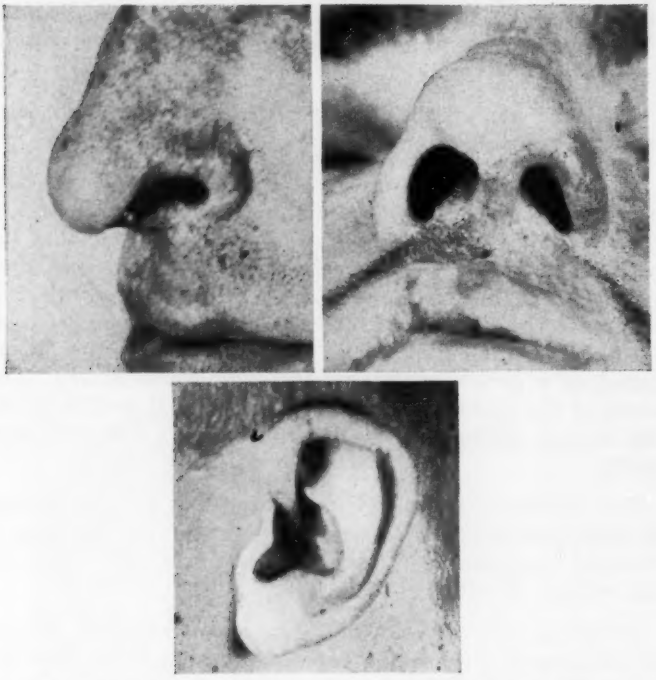

Fig. 2. Restoration of ala, angle and columella in one operation by a free composite graft from the ear. The ear is shown after later detachment from the head by a split graft. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

The nasal defect is prepared by cleanly excising the edges and then preparing a pattern of sheet lead or celluloid. An area is located on the helix of the ear having approximately the same curvature as the missing portion of the nostril border. The pattern is traced; and with a stab blade this portion is excised, taking care not to separate the parts of the composite graft from one another. The graft is sewed accurately into the nasal defect, and pressure is applied with internal packing and an external aluminum splint. The raw edge of the ear is buried under the postauricular skin for two weeks and later

detached with a flap of this skin attached to it so that the flap may be rolled into a little tube to replace the missing portion.

Pelliciari[3] reports the reconstruction of the nasal tip with multiple composite free grafts.

Total Reconstruction—A pedicle-flap restoration of the nose is necessary if the whole feature or any considerable part of the framework is gone. Brown and McDowell[2] find that the best flap is one from the forehead, as this skin has better rigidity, color and texture for the repair, and contracts less than any other flap (see Figs. 3 and 4). A forehead at least 7 cm. high is essential. After delaying it twice, the flap is raised on a pedicle containing the supraorbital artery. The lining of the nose is made by turning the distal portion of the flap inward, and with local delayed flaps or a free split skin graft.

The "forehead rhinoplasty" is still the most popular method of nasal reconstruction according to Penn.[4] He describes a forehead flap based on the supraorbital vessels and raises the flap without a primary delay.

Structural Grafts to Nose—Brunner[5] reports on the fate of an autogenous-rib-cartilage transplant to the nose after 21 years. The cartilage in the dorsum nasi was broken up, and cartilage in the columella preserved its gross appearance. Denegerative changes of the cartilage were of minor importance as compared with invasion of the cartilage by connective tissue. Cartilage covered with perichondrium is more resistant to this invasion than cartilage without perichondrium.

Cottle and co-workers[6] report on the successful use of cancellous iliac bone grafts in nasal repair.

Seeley[7] prefers to use composite bone grafts of cortical and cancellous bone taken from the ilium to correct a saddle nose. Through alar-rim incisions the alar cartilages are dissected free, and the soft tissues are elevated over the dorsum. The "wedge bone graft" is then inserted, and bony union results. No absorption has been seen.

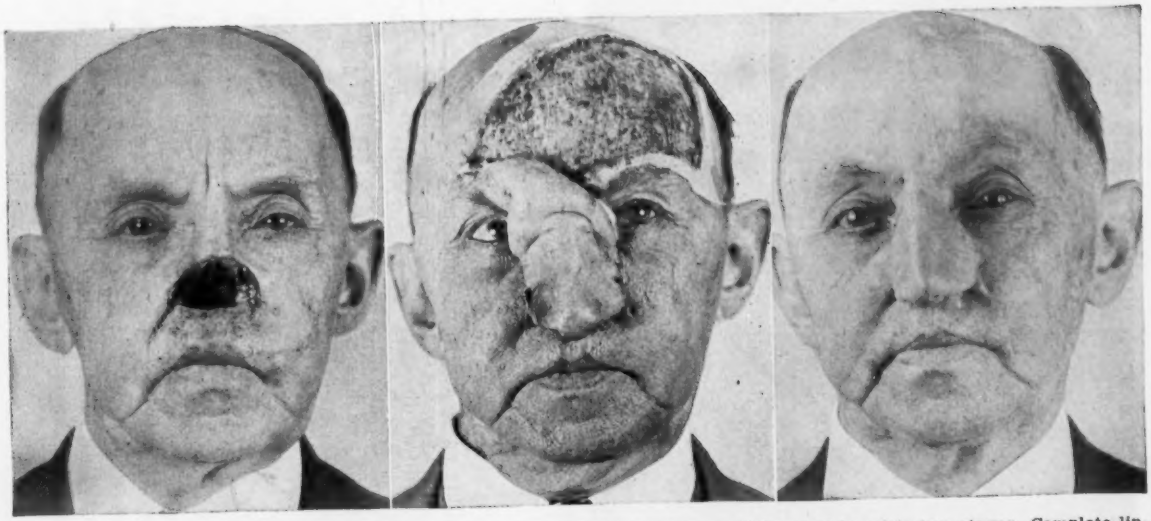

Fig. 3. Reconstruction of almost the entire nose by means of a forehead flap which was delayed in two stages. Complete lining of the new nose is essential in this type of "Indian" rhinoplasty and was obtained partly by turning down the skin from the bridge of the old nose and partly by turning the end of the forehead flap up into the new nostrils to meet it. The forehead was repaired by a split graft at the same time the pedicle was returned. L-shaped preserved rib cartilage graft inserted into the nose to provide skeletal support. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

Fig. 4. Profile views of the patient in Fig. 2 before and after reconstruction. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

Fox[8] reports seven cases in which tantalum implants have been successfully employed in rhinoplastic procedures.

Columella—Gillies[9] discusses methods of repair for loss of the columella. A free composite ear graft is suitable if the septum is present and has a good blood supply. A flap may be used from the forehead, hand or arm. Bilateral nasolabial flaps may be used to reconstruct the columella. He describes a method, not before recorded, of using alar-margin flaps to make a columella.

Griesman[10] discusses "the mechanism of the suspension of the upper lip, because interference with this mechanism is the main danger of surgical treatment of the columella." The columella, nasolabial angle and the upper lip can be mobilized and separated by an intranasal technique. This method does not seem to disturb the shifting mechanism of the upper lip.

Cleft-Lip Nose—Huffman and Lierle[11] from clinical experience have gained the impression that the malformation of the nose associated with cleft lips is due not so much to inherent aberrations of the size and shape of the elements of the nasal skeleton (cartilaginous and bony) as it is to their being held in faulty positions. It is folly to try to build a straight nose on a crooked septum. If the septum lies to one side or the other of the midline, its replacement in a normal position is obligatory before the external nasal deformity is attacked.

Rhinophyma—Wehr[12] reports a case of rhinophyma treated by excision without skin grafting. The rhinophyma was shaved off with a razor.

Rhinoplasty—Marmor[13] feels that a corrective rhinoplasty, when complicated by obstructive deviation of the nasal septum, is better done in two stages, except in selected cases. McLaughlin[14] describes a case of early absence of the septal cartilage due to birth trauma. Restoration of the correct facial contour is done with dermal and bone grafts. Tausend[15] introduces an instrument he calls the "accurator." Its purpose is to assist in the trimming of the anterior border of the cartilaginous septum during a rhinoplasty.

EYEBROWS.

Eyebrows are important and can be replaced as described by Brown and McDowell[2] with strips of scalp transferred as free full-thickness grafts or as island flaps. Care should be taken in selecting the graft or flap so that the hair will be growing as nearly in the correct direction as possible. Free grafts are removed from the scalp just behind and above the ear and are cut through the entire thickness of the skin and subcutaneous fat. The graft is then inverted over an assistant's finger or on a table and each tiny grain of fat is dissected off with a fine thumb forceps and small iris scissors. When this is complete, the undersurface of the graft will be covered with the bulbs of the hair follicles like a fine brush. The graft is then sutured in place and a pressure dressing applied.

EYELIDS.

Brown and McDowell[2] correct ectropion of the eylids in one operation. Free grafts are put in place after the deformity has been freed by careful dissection (see Fig. 5). Most everted lids have sufficient mucosa to allow for protection of

Fig. 5. Severe ectropion of all four lids with marked conjunctivitis and global irritation. Repair of all lids with thick split grafts, doing one set of lids (upper and lower) at each operation. Patient still needs a little more skin in the right canthus. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

the globe if the skin covering can be obtained. The repair is made by carefully opening the junction of the everted mucosa and skin, turning the mucosa as a flap toward the globe, and then covering the whole raw surface with a thick split graft or full-thickness graft or a direct pedicle flap from forehead or temporal region (see Fig. 6). Full-thickness grafts from the supraclavicular area are best (see Fig. 7). The free graft may be held in place by using a local "stent" type of fixation with the long edge sutures tied over mechanic's waste and then an overall pressure dressing.

Marcks[16] prefers to remove tumors about the eyelids with "scalpel surgery." He stresses the importance of a wide removal of the tumor and primary repair of the defect, for which he prefers a free skin graft. He does not attempt to discuss the secondary repair of the defects.

Straith and Lewis[17] offer the first report in the American literature of the Treacher Collins syndrome. This is an associated congenital deformity of the eyelids, ears and malar bones. The palpebral fissures are oblique and slant downward laterally. There is a deficiency of eyelashes from the middle portion of the lower eyelids, underdevelopment of malar bones and deformities of the ears with receding chin.

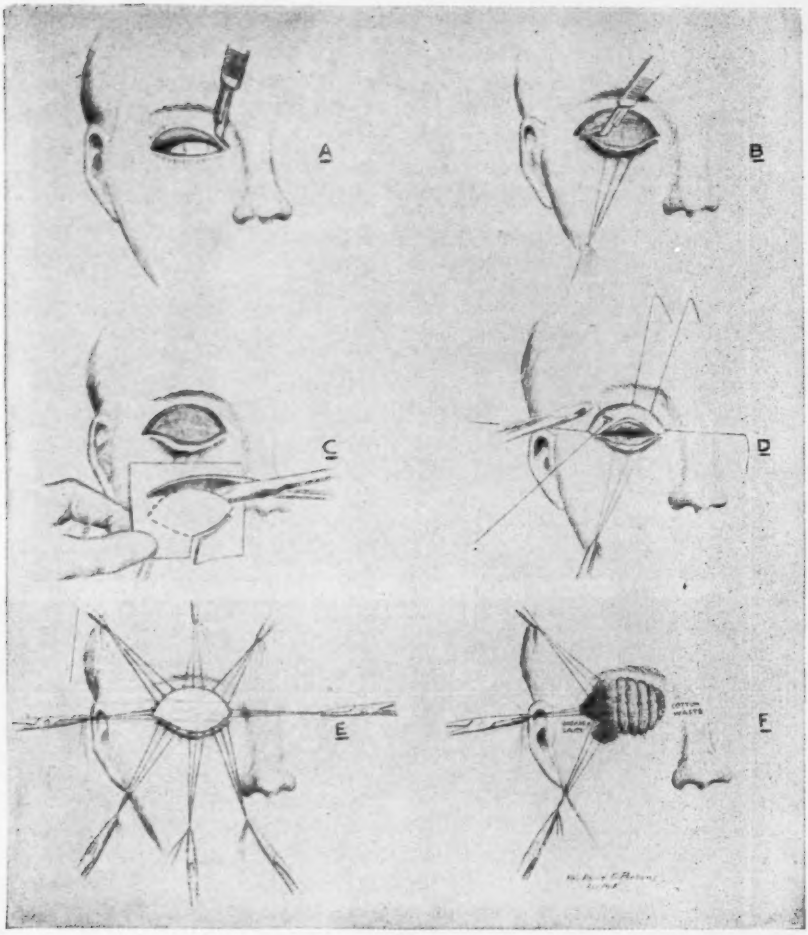

Fig. 6. Contracted area opened; surface and deep scar removed as necessary to allow a little more than normal expanse. Where pressure alone cannot be relied upon—as on the lids—the fixation is obtained and the proper opening of the area maintained by tying the long edge sutures over a pad of cotton waste, often first covering the graft with fine mesh grease gauze. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

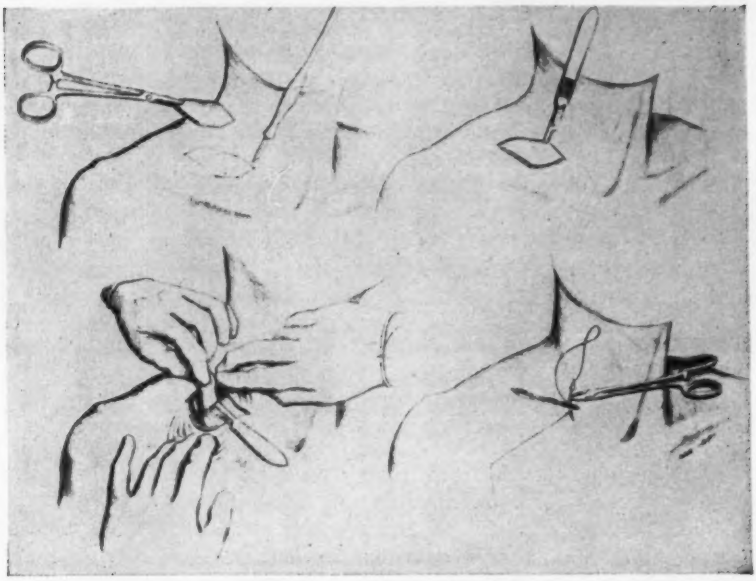

Fig. 7. Pattern of celluloid or other material traced on the neck with a pen and 5 per cent methylene blue. Assistants stretch the area taut to facilitate removal of the graft which is held with the fingers to avoid forceps marks. The wound is closed in layers with fine sutures. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

EYE.

Metallic imprints and integrated artificial eyes which provide an improved cosmetic appearance, both static and dynamic, have been developed by Hughes.[18] The integrated vitallium implants are partially buried in the orbit after the enucleation or evisceration of the eye. Some have been extruded.

Kiskadden, *et al.*,[19] report four cases of congenital anophthalmos successfully treated with acrylic forms of increasing size until an artificial eye of the size of the normal eye could be worn. The gradual dilatation of the conjunctival sac appears to help in the development of the orbit if begun at a very early age. The patient does not have to be old enough

to cooperate. This method of treatment gives much more satisfactory results than surgical enlargement of the conjunctival sac with skin grafts.

EAR.

The total reconstruction of an ear can be done by Brown and McDowell[2] in as few as three operations (see Fig. 8).

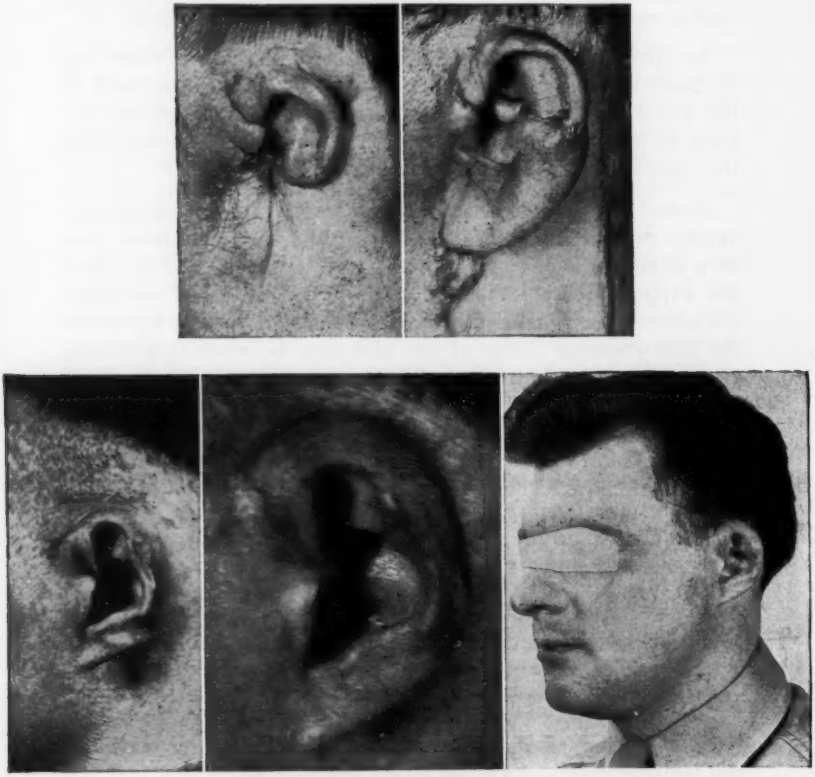

Fig. 8. Gunshot loss with occlusion of canal that was opened with flaps of local tissue. Reconstruction done with neck flaps brought up in stages with preserved cartilage support. (Bottom) Loss of about one-third of bulk from fire. Reconstruction with local flap preserved cartilage and split graft. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

Whatever is left of the stump of the ear is implanted under a scalp flap behind and above the ear. In two or three weeks when the union is adequate, a piece of costal cartilage is inserted under the scalp flap. In another three or four weeks the cartilage is dissected free of the skull so as to leave soft tissue attached to the undersurface of the cartilage and to the skull. The raw surface is covered with a single large thick split graft. A small tubed flap from the immediate neck region can be added for the helix if the patient desires.

An operative method to correct protruding ears is described by Becker[20] in some detail. The ear is set back to the head at the proper angle, and the postauricular sulcus is not obliterated, as in the procedures in which large sections of skin over the mastoid area and the auricle are removed.

Blake[21] has constructed seven ears with "prefabricated autogenous ear cartilages." The skin for the ear is supplied first by a tubed pedicle from the upper arm. To this is later added the supporting structure by a laminated sheet of cartilage shaped to a reasonable likness of a normal pinna by burial in the subcutaneous tissue of the abdomen between thin sheets of tantalum. A small piece of the eighth or ninth right costal cartilage is removed. The cartilage is cut into coarse flakes and spread and squeezed tightly between the plates of the tantalum sandwich or shaping cup and buried beneath the abdominal skin. The tantalum sandwich is removed three to seven months later and the laminated piece of cartilage inserted through an anterior incision into the soft tissue of the ear.

Wynn[22] has reconstructed an ear lobe as a one-stage procedure by wide undermining of the adjacent skin of the neck.

CLEFT LIP.

Le Mesurier[23] finds that in a complete unilateral cleft lip the cleft is pretty wide, although there is little real lack of tissue. The chief problem is to get sufficient tissue at the lowest edge of the lip to produce the desired pouting appearance. A quadrilateral flap from the cleft side of the lip is

designed to fit on the medial side into a notch formed by the spreading apart of the two edges of a cut. A cupid's bow is formed. It is best to operate when the infant is three months old.

Steffensen[24] follows the same method of cleft-lip repair and reports uniformly good results. "Poor results have been due to the surgeon's inaccuracy in the finer details of approximation and not to the plan."

Dingman, *et al.*,[25] present evidence to show that blood loss is not excessive in the cleft-lip and cleft-palate operations if the usual methods for the production of hemostasis are followed. In bilateral cheilorrhapy, blood loss does approach the dangerous level. The addition of vasoconstricting agents even in very small concentrations is valuable in further reducing the blood loss.

Browne[26] discusses the elements of the deformity of the complete double-cleft lip. The failure of development of the columella is noted early; however, if the lip is closed, the columella will stretch out of itself. If the failure of development of the labiogingival sulcus is not remedied, the lip is immobile, the dental plate cannot be fitted and the muscle of the oral sphincter cannot be closed properly. The displacement forward of the premaxilla must be corrected by removal of the "prevomerine bone." The cleft of the lip should be closed with no skin of the lateral portions of the lip beneath the prolabium. The vermilion of the prolabium should not be used, as the muscles should meet and join under the skin of the prolabium.

Browne[26] sets back the premaxilla when the patient is three months old. The prevomerine bone is removed and the premaxilla set back and held in place with a special spiked plate and a suture through the alveolar ridge. The cleft alveolar ridge is closed at this operation. The second stage in the closure of the double-cleft lip is done four weeks after the first. The cheeks are undermined widely. The prolabium is converted into a "V," and the margins and vermilion are sutured to form a cupid's bow.

Huffman and Lierle[27] repair double clefts of the lip in three stages. First, the premaxilla is set back and the cleft of the hard palate closed. At the second operation, one side of the cleft lip is closed, and the other side at the third operation.

Three unusual clefts of the lips are illustrated by Braithwaite and Watson.[28] One patient had a cleft of the lower lip with agenesis of the mandible, eye and ear. Another showed a central cleft of the upper lip with a very small premaxilla and prolabium and a hole in the alveolar ridge only. Another presented a central notch of the upper lip.

As only five cases of macrostomia have been reported in Europe since 1881 and none in this country, Clifford[29] reports a case and its surgical correction.

Pickerill[30] has the mother nurse the infant patient undergoing surgery. This he feels has cut down on cross-infections. All dressings are done in the operating room with anesthesia. No one else will spend the necessary time and care that a mother will to care for her child during the postoperative period.

CLEFT PALATE.

Baxter and co-workers[31] write that the aim of surgery of the cleft palate is not only to close the defect but to establish normal speech. The latter objective is not obtained in many cases, owing to the anterior pull of the contracting raw surface on the nasal side of the mucoperiosteal flap, which results in a short palate. To prevent this, the authors apply a split thickness skin graft to the raw surface on the nasal side of the mucoperiosteal flaps. Three weeks later the cleft is closed and the palate set back. They now find it unnecessary to sever the greater palatine arteries to set back the palate. Palatal massage is begun four to six weeks after the operation. The authors feel that speech is markedly improved and that the palates are longer with their procedure.

Graber,[32] using mainly Roentgenologic means, has studied the bony face in cleft palate cases. He feels that early closure of the cleft palate will in some instances limit the growth

potential of the maxilla denture. Limiting bands of scar tissue from the cleft-palate surgery may interfere with maxillary development. Slaughter and Brodie[33] also find that surgery of the cleft lip and palate, if poorly executed and poorly timed, can do more damage than good by inhibiting normal growth. This interference is directly proportional to the amount of injury to growth centers and to diminution of blood supply to the parts concerned. Other evidence is available to show that congenitally deformed parts, unless permanently damaged, grow at normal rates.

Trauma to the upper surface of the soft palate and opposing surface of the pharyngeal wall caused by operations for adenoids and tonsils may result in nasopharyngeal stenosis. Vaughn[34] corrects this by separating the soft palate from the pharyngeal wall and covering the raw opposing surfaces with local mucosal flaps.

MANDIBLE.

Prognathism—Waldron, *et al.*,[35] stress the fact that in the surgical correction of prognathism, it is the surgeon's responsibility to secure both cosmetic improvement and a maximum degree of restoration of dental function. Blind division of the ramus or of the condyle neck should not be attempted. There should be exact open-view control of both proximal and distal fragments after division of the mandible. With adequate preoperative study, effective splinting and immobilization, and adequate postoperative care, complications are rare when ramus osteotomy, retromolar resection or molar resection techniques are employed.

Reconstruction of Mandible—The techniques of mandibular reconstruction following nonunion of fracture or loss of bone originated during the first World War. Ivy, in 1920, reported a series of 103 cases. Between the two World Wars clinical experience with cancellous bone gave abundant evidence of its superiority to cortical bone. A survey by Blocker and Stout[36] of bone grafts to the lower jaw performed on service personnel in World War II shows that 1,010 grafts were performed. Sources of the graft were: ilium, 836; rib, 151; and tibia, 23.

Primary union occurred in 917 cases. There were 93 failures, of which 68 were successfully regrafted. The percentage of primary takes was 90.7 per cent and of final takes was 97 per cent.

A 25-year-cure of a giant-cell tumor of the mandible treated by currettement and X-ray is offered by Straith.[37] Five years after the removal of the tumor, a mortised iliac-bone graft was inserted for a nonunion of a fracture at the site of the removal. Functional and cosmetic result 20 years later is excellent.

Immediate reconstruction of the lower jaw following surgical excisions of large tumors has been accomplished by Marino, *et al.*,[38] in two patients. The resection of tumor of the mandible is carried out in the usual fashion, making as large an opening in the buccal cavity as may be necessary. Cancellous bone chips are taken from the iliac bone. The oral mucosa is closed, and the bone chips are inserted into the wound from which the tumor has been removed. The masseter and internal pterygoid muscles are then sutured together under the lower border of the bone graft. The wound is closed and drained. An acrylic oral splint, external plaster splint, and interdental wiring are used for immobilization. Excellent functional and cosmetic results are reported in a case of an adamantinoma and of a sarcoma of the mandible. The sarcoma occurs postoperatively.

Adams[39] reports a case of bilateral hypertrophy of the masseter muscle. The surgical correction was accomplished by excision of a segment from the lower inner aspect of the muscle and removal of the protruding angles of the mandible.

Ivy[40] has corrected a case of benign hypertrophy of the mandibular condyle by surgical removal of the condyle. This was accomplished through a two-inch skin incision made beneath the left angle of the mandible. Part of the masseter muscle was reflected from the outer surface of the ascending ramus. A Blair curved pedicle needle was passed in the depths of the wound behind the neck of the condyle to emerge through the sigmoid notch beneath the zygomatic arch. A Gigli saw

was passed around the neck of the condyle, and the neck was divided and the condyle removed. Functional and cosmetic result was excellent.

FACIAL INJURIES.

Immobilization of jaw fractures with internal wire pins is discussed by Brown, Fryer and McDowell.[41] When enough teeth are present, interdental wiring is the method of choice in the treatment of fractures of the mandible. When, for some reason, interdental wiring or other fixation would not be sufficient, the fractured lower jaw can be immobilized by a Kirschner wire, 0.05 to 0.08 inch, driven across the fracture site. Among the numerous indications for which this method has been frequently used are: lack of available teeth (see Fig. 9); symphysis fractures; fractures at the angle with the posterior fragment displaced into the upper buccal fornix (see Fig. 10); and when there is compounding into the mouth with infection and sloughing (see Fig. 11). In an edentulous mouth internal wires can be used in conjunction with circumferential wires around the patient's dentures (see Fig. 12). The wire should be driven across the fracture site with a power drill. Complications following the use of the internal wires have been slight, confined for the most part to slight drainage around the wires.

Mowlem[42] states that the most important causes of nonunion of the mandible are *1.* mechanical trauma and *2.* infection. Nonunion occurs in fractures of the body and symphysis and is rare in fractures of the condyle, angle and ascending ramus. Important factors that may contribute to nonunion are *1.* delay in fixation, *2.* inadequate reduction, *3.* inefficient fixation, *4.* tooth remnant or teeth in the fracture line, and *5.* gross contamination of the mandible. Before bone grafting can be performed for nonunion, *1.* all oral fistulas must be closed, *2.* all draining wounds must be eliminated for at least eight weeks, *3.* tooth fragments must be removed from the bone ends, and *4.* there must be an adequate means of immobilization.

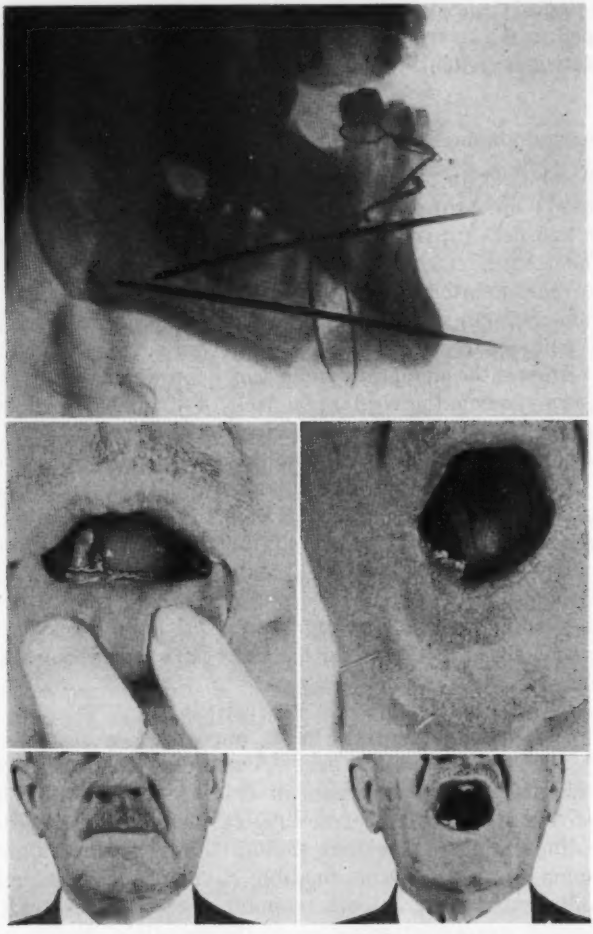

Fig. 9. Severe, splintered locally infected lower jaw widely compounded by anterior fragment being driven into the mouth, reduced and held immobilized until union was solid, by combination of internal wires, circumferential wire and arch constructed of twisted No. 24 steel wires. Normal opening action and ingestion of soft food possible during comfortable convalescence and on complete healing. (Brown, J. B.; Fryer, M., and McDowell, F. Plastic and Reconstructive Surgery, 4:31, Jan., 1949.)

Fig. 10. Treatment of difficult fracture at angle without teeth to control posterior fragment, made simple and direct by internal wire driven through angle, across fracture site, into body of the jaw. Interdental wiring done because of associated fracture of the body of the mandible. (Brown, J. B.; McDowell, F., and Fryer, M.: Plastic and Reconstructive Surgery, 4:32, Jan., 1949.)

Cardwell[43] recommends reduction of fractures of the zygomatic tripod via an intranasal approach, using an appropriate male urethral sound. The operation can be done under local anesthesia. Gordon[44] describes a method for maintaining position in fractures of the malar bone in cases in which reduction is delayed for five or more days. The depressed portion of the malar bone is elevated. If the reduction cannot be maintained, a long bayonet skin needle is driven in through the malar to the nasal or nasal process of the maxilla. This gives good immobilization and maintains the reduction.

Moore and Ward[45] stress the importance of the early treatment of fractures of the facial bones. Severe deformities of the face may be due to untreated fractures of the face. Maxillary fractures may be classified as follows: *1.* horizontal fractures of the maxilla passing through the base of the nasal

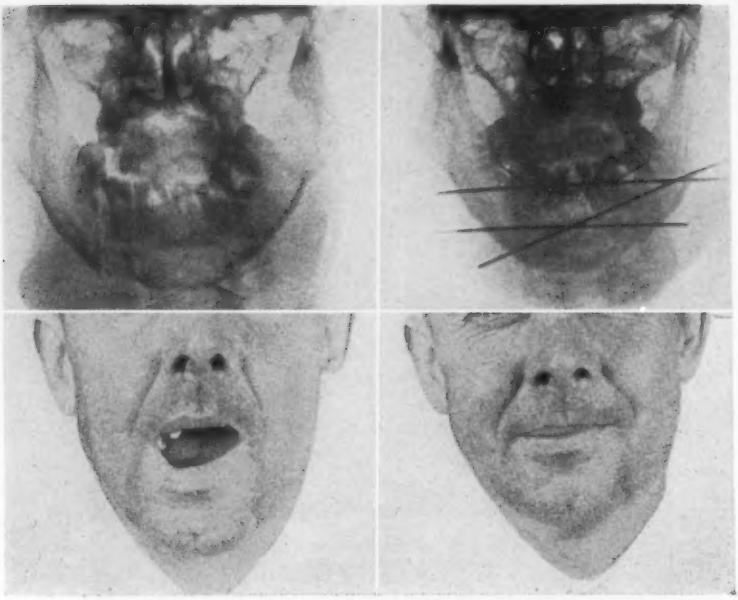

Fig. 11. (A) X-ray fails to show fine comminution of whole central segment of the lower jaw which felt like a "bag of salt," requiring, as shown in (B), three internal wires with twisted steel wire arch for definite immobilization. Local low grade infection with associated swelling of surrounding soft tissues and absence of usable teeth demanded the direct method of immobilization. (C) and (D) taken on removal of wires at eight weeks' time with normally opening, solid jaw. (Brown, J. B.; McDowell, F., and Fryer, M.: Plastic and Reconstructive Surgery, 4:33, Jan., 1949.)

and ethmoid regions, across the orbits, to the zygomatic arches; *2.* pyramidal fractures; *3.* low transverse or Guerin's fracture; *4.* vertical or unilateral maxillary fracture; *5.* depressed or comminuted fracture of the malar bone. If the fractures are not treated adequately early, they have healed in six weeks in malposition. Correction should be obtained not by camouflage methods only but by total refracture, reduction and immobilization of the fragments. By this method full correction of diplopia was possible in 22 of 26 cases.

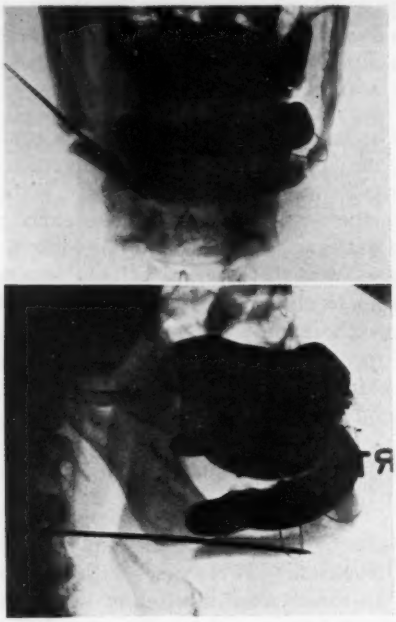

Fig. 12. "Pipe-stem" sized, edentulous lower jaw held steadily with the fracture in the body stabilized by circumferential wires around dentures and that at the angle immobilized by an internal wire, avoiding reduction. Healed solidly at eight weeks. (Brown, J. B.; McDowell, F., and Fryer, M.: Plastic and Reconstructive Surgery, 4:34, Jan., 1949.)

FACIAL REPAIRS.

The use of the tube pedicle in facial reconstruction is usually reserved for those cases lacking sufficient adjacent material for repair by other means. Steiss[46] finds the neck is a good donor site because of color match, the scar can be hidden and the blood supply is exceptional. Five cases of repair of facial defects with tube pedicles are reported.

Macomber[47] prefers to use autogenous bone grafts in correcting depressions of the forehead, nose and chin. Bone may be obtained from the crest of the ilium under local anesthesia. Cancellous bone is preferred, and cortical bone is used only

when rigidity is at once required. The bone grafts become promptly fixed and retain their original dimensions when placed in vascular tissue, in contact with denuded bone or periosteum.

Dermal grafts have gained a definite place among the armamentarium of the plastic surgeon, for the reconstruction of facial contours. Schuessler and Steffanoff[48] state that dermal grafts tend to increase in volume in the early postoperative period, owing to the vascularization of the graft, and later on show a decrease from the original volume (approximately 15 per cent), owing to absorption. Of the 80 dermal grafts performed by the authors, only 7.5 per cent showed complications, and only 1.25 per cent of these showed epidermoid cyst formation. The hair-free areas of skin inside the thighs, on the abdomen and on the back offer the best donor sites for the dermal grafts. If the defect is so extensive that more than four layers of dermis must be used, then the correction should be carried out in stages.

Free fat grafts to the face for the repair of deformities is discussed by Stevenson.[49] Three cases with satisfactory results are reported. In these cases an attempt was made to implant an excess of about 50 per cent to allow for shrinkage.

Rubin[50] has successfully used polyisobutelene as a fat substitute in cheek deformities. Polyisobutelene is an artificial rubber. It is not as soft as fat, but it is well tolerated by the body and can be placed in the cheeks with no disturbance of the smiling mechanism. The body reaction to it is no greater than it would be to any inert foreign material as silk or nylon.

Polyethylene can be tooled to produce strings or "hairs" of the material. Teplitsky and Rubin[51] have successfully implanted masses of this polyethylene hair to fill out depressions of the face. The foreign-body reaction to it is slight.

Hemihypertrophy of the face is thought to be due to a defect of the germ plasm by Sutton.[52] A case and its surgical correction are presented. Weaver[53] reports the removal of tattoos of the face by excision and the use of sandpaper.

There are only nine reported successful primary repairs of severed parotid ducts, according to Sparkman.[54] He reports three additional cases. The anastomosis of the severed duct was done over a ureteral catheter. Multiple fine silk sutures which did not penetrate the duct lumen were used. The catheter was withdrawn at the conclusion of the anastomosis. A postoperative regimen which favored continued secretory activity of the gland was followed. No strictures were noted.

Bailey and Skaff[55] repair the severed parotid duct over a heavy thread which acts as a dowel. The dowel is anchored at each end with a lead shot. Five cases are reported.

NAEVUS.

Delario[56] presents an extensive classification of the common nonvascular naevi. He recommends prophylactic removal of naevi to prevent malignant degeneration if they are darkly pigmented, appear suddenly late in life, are subject to trauma, and naevi that show increasing pigmentation and size. Pack has reported a 14.7 per cent five-year survival in 267 patients with malignant melanoma treated with surgery.

ANGIOMA.

Brown and McDowell[2] write that port-wine stains should be considered as congenital anomalies of the capillary system in the derma, rather than as tumors. Some can be disguised successfully with cosmetics. They are almost uniformly insensitive to radiation in any form. Clean surgical excision with immediate free skin grafting is nearly always preferable to any destructive type of therapy. But the results are not perfect, and the problems should not be approached with great optimism (see Fig. 13).

Reidy[57] also stresses that capillary hemangiomas are insensitive to radiation. Port-wine stains in children may be treated with thorium. Excision and skin grafting of port-wine stains is the therapy of choice in others.

Fig. 13. Single operation repair of port wine stain. The hemangioma was dark and could not be covered satisfactorily with special cosmetics. Surgically excised and covered with free full-thickness skin graft. Result shown six months later. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

The dramatic effect of a cure of a cirsoid aneurysm treated by surgical excision is reported by Grimes and Freeman.[58] This aneurysm consists of two parts: the arteriovenous fistulas and the dilated afferent and efferent vessels. They are most frequently traumatic in origin and usually occur on the face, scalp, hands and feet.

There is still some question as to whether lymphangiomas are true tumors or congenital anomalies, but they do slowly increase in size and may become horribly disfiguring when present on the face. They are insensitive to irradiation. Brown and McDowell[2] prefer subcutaneous excision, if the overlying skin is not too warty or pigmented. At times, the

skin is so ugly and the lesion so large that it is best to excise the whole thing and cover the area with a flap or graft.

MAMMAPLASTY.

Maliniac[59] states that the objectives of a mammaplasty should include esthetic form and conservation of function, as well as reduction in size. Preservation of blood supply, proper shaping of the gland and skin, and adequate mastoplexy are essential elements in all mammaplastic procedures. He describes a retromammary mammaplasty[60] which is a substitute for mammectomy with free grafting of the nipple, when the hypertrophy is mainly in the anteroposterior direction, and when it is desired to preserve the sensitivity of the nipple. The procedure consists of retromammary resections from the gland; the central segment, including the nipple, is preserved. This is followed by mastopexy by means of dermal loops and a double-flap skin plasty. In lesser hypertrophies transposition can be carried out in one stage. Mammaplasty with free grafting of the nipple should be performed only in true hyperplasias or in hypertrophies with advanced nodular cystic degeneration.

Bames[61] disagrees with Maliniac concerning the surgical treatment of gigantomastia. A one-stage mammaplasty with transposition of the nipple cannot be adequately and safely done on excessively large breasts. The excessively large breasts usually have little lactogenic function and, therefore, there is no reason not to do a one-stage mammaplasty with free transplant of the nipples. If a two-stage mammaplasty is planned to avoid free transplantation of the nipple, the patient frequently refuses the second operation.

Aufricht[62] corrects pendulous breasts at a one-stage procedure carried out simultaneously on both breasts with transposition of the nipple. He stresses the preoperative planning and feels that breast tissue can be excised in any area, as all breast tissue is well vascularized and it is not essential to avoid any particular branch of the mammary arterial tree. Lamont[63] describes a one-stage bilateral mammaplasty with free transplant of the nipple for mammoth breasts. The oper-

ation is carried out with the patient in the sitting position. Adams[64] has reconstructed the nipple by a free transplant of the labium minus. Brown[65] illustrates the construction of a bilateral one-piece latex breast prosthesis.

Foged[66] summarizes the operative treatment of abdominal-wall obesity in 35 patients. He recommends transverse excision of skin and fat between the umbilicus and the symphysis pubis.

FREE SKIN GRAFTING.

Baxter, *et al.*[67] and Thorek and Engel[68] have reported resurfacing of the penis with split skin grafts. Blanchart[69] has repaired an avulsion of the entire scalp and forehead with split thickness skin grafts. McCash[70] uses a plaster-of-Paris head cage in the fixation of free skin grafts to the head and face.

That contractures of the neck can be corrected with free skin grafts is well shown by Brown and McDowell.[2] If the repair is done before the area is healed, split grafts are always utilized. The deformity may be so great that the patient cannot look the world in the face and a wide open bite of the jaw may develop (see Fig. 14). The opening of the contracture is carried transversely completely across the neck and often out into normal skin on either side. All heavy dense scar is excised, and the remaining normal edge of tissue is dissected back to its normal position. Thick split grafts or full thickness grafts are used and fixed with a mechanic's-waste stent and a large pressure dressing.

Hypospadias repairs are effected by Young and Benjamin[71] in the preschool child with free inlay grafts. The chordee is corrected in one operation when the child is one year old. This is accomplished by complete exposure of the corpora cavernosa, excision of the fibrous remnants of the corpus spongiosum, the furrow in the glans, and often of part of Buck's fascia. The urethral orifice is transplanted laterally and backward, the halves of the glans and prepuce brought together, and the skin closed in zigzag fashion. The urethra can be

Fig. 14. Repair of contracted neck and axilla. Restoration was begun by completely releasing the neck deformity and covering the area with thick split grafts; at a second operation split grafts were used in the axilla, and later a full thickness graft was put across the front of the neck to give the final smooth appearance. (Brown, J. B., and McDowell, F.: Skin Grafting. Philadelphia, Pa.: J. B. Lippincott Co., 1949.)

reconstructed in a two- or three-year-old patient in one operation with a free inlay skin graft. A urethrostomy is performed high in the perineum to divert the urinary stream. A hairless dermatome graft is taken from the inner aspect of the arm for the inlay. The urethra is completed in one operation. There are certain advantages in this operation. The urethra has a normal exit in the glans penis. The urethra contains no hair. Multiple fistulas do not occur. No case of stricture is reported, and prolonged and frequent dilatation of the urethra has not been necessary.

Homografts of skin are discussed by Brown and McDowell.[2] These grafts may be lifesaving in certain instances. They take almost as well as autografts and may survive for from three to 10 weeks. During this time there is often a stimulus

to epithelization so that complete healing may even occur after absorption of the grafts. This notable increase in wound healing has caused some observers to think that homografts survive permanently; but it is doubtful whether this ever occurs except in the instance of identical twins. McCoy[72] reports a case of homografting. Kearns and Reid[73] report two successively applied homotransplantations of split skin grafts from each parent to a burned boy. The grafts are reported present two years later.

The treatment of elephantiasis of the lower extremity is covered by Blocker.[74] This is a gravitational edema superimposed upon chronic obstruction of the lymphatics, aided and abetted by repeated bouts of acute infection. He attempts to excise as much diseased tissue as possible and replace it with healthy skin and guard against further gravitational edema by the use of supportive stockings. Following two weeks of bed rest, the skin and subcutaneous tissues are removed and replaced with skin grafts. Complete bed rest is enforced for 60 days.

By the topical application of dibromopropamidine (Mand. B. 1270) to wounds, surface infections caused by Proteus vulgaris and Pseudomonas aeruginosa can be eliminated, according to Champion and McDowell.[75] Clinical and experimental work by Localio, *et al.*,[76] seems to indicate that the administration of dl-methionine will assist in the healing of wounds in protein-depleted patients.

Robinson[77] has studied the blood loss from donor sites using the weighed-sponge method. It has been found that about 46 cc. of whole blood is lost per dermatome drum of skin removed. Straatsma[78] discusses the embryology of skin. Inexpensive replaceable blades for the Blair knife have been introduced by Brodenham.[79] The regeneration of sensation in grafted skin has been extensively studied by Hutchison, *et al.*[80]

PEDICLE FLAPS.

Brown, *et al.*,[81] stress the necessity of the cooperation of the plastic, orthopedic and neurologic surgeons in the restoration

of major defects of the arm. Compound injuries of the arm that cause wide loss of soft tissues and bone leave crippling defects. Healing is by dense, avascular fibrous tissue. The scar epithelium is unsatisfactory and repeatedly ulcerates. To obtain relief from this binding, distorting scar, with surface ulceration and deep fixation of bone, joint, tendons and nerves, there needs to be first removal of the scar and replacement of surrounding normal soft parts and bone to approximately their normal positions. The surface defect can then almost always be covered by an immediate short broad pedicle flap from chest or abdomen. Within 14 to 21 days the short broad pedicle can be severed and the surface coverage completed. After several weeks, work on nerves, bone and tendons can be done through adequate surface coverage.

Cannon and Trott[82] emphasize the value of direct flaps in extremity repairs. The reconstruction can be hastened and simplified without jeopardizing the result. Remote flaps can be completed in two operations about four weeks apart with a sufficiently broad pedicle. Delays in detaching these broad flaps are necessary only if the pedicle itself is to be used in the resurfacing.

Conway, Stack and Docktor[83] from work on experimental animals conclude that both the saline-wheal test and the fluorescein test give more accurate evaluation of the circulatory efficiency of a tubed pedicle than do clinical observations alone. Cuthbert[84] describes a "marsupial" skin flap to cover large rectangular skin defects. Five operative procedures are necessary.

Hynes, *et al.*,[85] use a fluorescein test for determination of the blood supply of tubed pedicles. Ten cc. of a 5 per cent solution of fluorescein are injected intravenously. A bowel clamp is placed across the end of the tube to be divided. A series of intradermal wheals is raised at intervals of 2 to 4 cm. along the length of the tube with 1:1000 histamine phosphate. Under ultraviolet light the progression of the fluorescence along the tube is observed. Using this test and the atropine-absorption test, Hynes[86] is able to effect the rapid

transfer of abdominal tubed pedicles to the lower extremities. In suitable cases abdominal tubed pedicles have been transferred to the leg in three instead of four stages.

DECUBITUS ULCERS.

A report of 334 operations for closure of decubitus ulcers in paraplegics has been prepared by Blocksma, *et al.*[87] As most of those patients were ambulatory and sitting several hours each day, 178 of the operations were for ischial decubiti. Sulfasuxidine was used preoperatively and postoperatively. The tendency has developed to become more radical in the excision of the decubitus ulcer and the underlying bone. The underlying bone was found diseased in 75 per cent of the specimens. Sacral decubiti were best repaired by local pedicle flaps to fill the defect after excision of ulcer and projecting bony spine. After excision of trochanteric decubitus and the greater trochanter, an anterior thigh flap is used to fill the defect. For an ischial decubius the ischial tuberosity is removed with Gigli saws. Battle[88] has also written on decubitus ulcers in paraplegic patients.

BURNS.

Wallace[89] presents a preliminary report on a series of superficial burns of moderate extent in babies and children treated systemically with penicillin, locally with penicillin powder, suspension immobilization and exposure to the air. Braithwaite[90] feels that plasma is satisfactory therapy of shock in patients with third degree burns covering an area not greater than 20 per cent of the body surface. Whole-blood transfusions should be used if the third-degree area is greater than 20 per cent. Eisenstodt[91] recommends that in the moribund burn patient the granulations not be removed at the time of skin grafting. He finds that thin split grafts will take with a hemoglobin as low as 30 per cent and a plasma protein level of five, and in the presence of infection Owens[92] directs attention to the presence of Sudeck's osteoporosis following first and second degree burns.

Braithwaite and Beales,[93] following the concepts of Perry and Shaw (1894), conclude that Curling's ulcers will become less frequent in burns as penicillin can be used to control the infection in the burn patient.

CHRONIC ULCERS.

Byars and Letterman[94] write that infection, general debilitation, hypoproteinemia, anemia and chronic shock occur as complications to chronic ulcerations. The only final satisfactory solution to the ulcer problem is to attain a well-healed wound at the earliest possible moment. The application of topical agents alone to a wound will not achieve healing. Large areas of skin loss by avulsion may be replaced immediately. The use of split thickness skin grafts is the most satisfactory solution to the chronic ulcer.

Douglas[95] suggests an explanation of the nonhealing traumatic ulcer. He has found striated muscle fibres in the scar in the base of these indolent ulcers. The enclosed muscle fibres produce an excess of fibrous tissue, the immediate cause of the nonhealing process. This disaster can be prevented by great care in the toilet of all operations, care being taken to see that the muscle sheaths are closed.

RADIATION BURNS.

Brown, McDowell and Fryer[96] emphasize that excessive exposure of the skin to radiation may produce changes in the skin that will require excision and repair. The changes are most commonly seen on physicians' hands due to exposure during fluoroscopy (see Fig. 15). Radiation burns occur on dentists' fingers (see Fig. 16) and on patients due to long fluoroscopic examination. These burns also result from excessive radiation treatment given acne (see Fig. 17), eczema, port-wine stains, epidermophytosis, pruritus ani and superfluous hair (see Fig. 18).

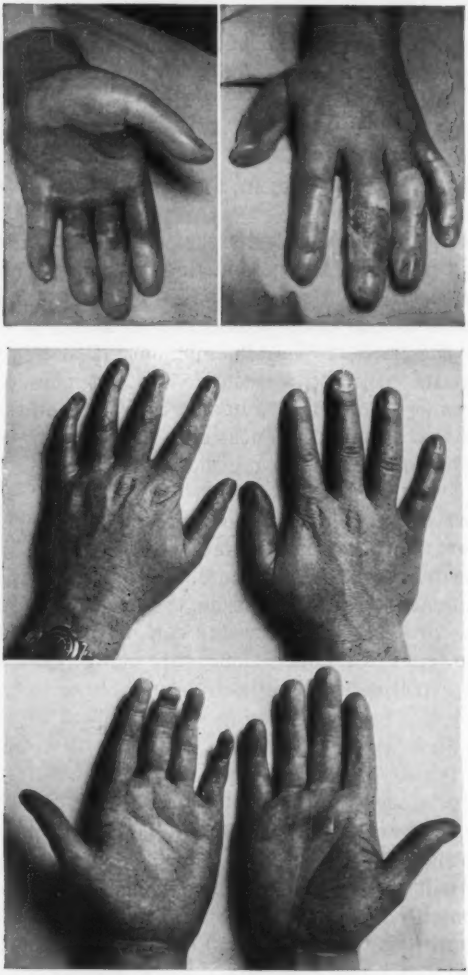

Fig. 15. Flouoroscopic burns of doctor. **(a, b)** Acute burns on both hands—left worse than right. Patient required 6 gr. of morphine a day. Patient came in with consideration of amputation of hand. **(c, d)** Result of general protective care and early resection and free grafting. Recovery was such that he was able to follow a full career in anesthesia, whereas he formerly was a surgeon. (Brown, J. B.; McDowell, F., and Fryer, M. P.: Surg., Gynec. and Obst., 88:609, May, 1949.)

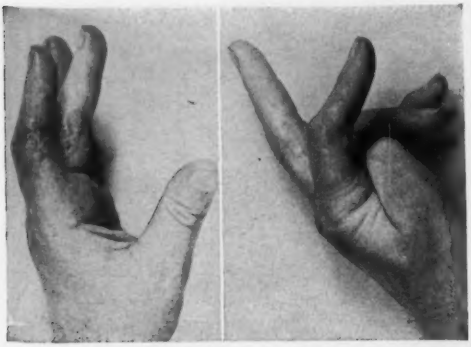

Fig. 16. Dentist's burns. Typical burn of dentist's fingers from holding films in patients' mouths. Resection with immediate split graft. One operation. (Brown, J. B.; McDowell, F., and Fryer, M. P.: Surg., Gynec. and Obst., 88:609, May, 1949.)

The pathologic process includes *1.* loss of skin appendages, *2.* replacement of normal collagen by dense acellular hyaline collagen, *3.* an obliteration of blood vessels of the corium, *4.* necrosis in the coremium about thrombosed telangiectases, *5.* coal spots, and *6.* carcinoma. Generally, telangiectases occur in three to 10 years, coal spots and keratosis in 10 to 15 years, and carcinoma in 20 to 25 years.

Severe acute radiation burns are very painful. They are less painful if covered with a bland ointment, a loose cotton dressing, and immobilized and elevated. The diagnosis of the chronic radiation burn is often overlooked. The triad of atrophy, telangiectasis and keratosis of the skin should lead to the diagnosis. The progress of the change to carcinoma is inevitable if the patient lives long enough. The excision and repair should be done before ulceration, pain and malignant change have occurred. Following excision of the irradiated skin the following variation in treatment may be useful sometimes: *1.* the wound is left open to be skin-grafted later, *2.* the wound may be dressed in a split graft and the patient advised that it may have to be repeated, *3.* immediate closure of the defect with adjacent or distant flaps, *4.* delayed closure

Fig. 17. Commercial hair remover burn. Excessive burning from commercial X-ray treatment to remove hair. Patient's arms, axillae and legs were completely burned. Treatment consisted of excision. In two stages of all skin of lower arm and immediate split grafting. (Brown, J. B.; McDowell, F., and Fryer, M. P.: Surg., Gynec. and Obst., 88:609, May, 1949.)

with pedicle flaps, or *5.* if bone or tendon is exposed, the use of pedicle flaps. There are two essentials: *1.* to get rid of the lesion, and *2.* to repair the area.

Fig. 18. Widespread involvement following treatment for acne. As usual the tip of the nose, being closest to the tube, is the worst burned. Repair by resection and immediate split grafting. Four operations were necessary to repair both cheeks, whole nose, upper lip. (Brown, J. B.; McDowell, F., and Fryer, M. P.: Surg., Gynec. and Obst., 88:609, May, 1949.)

Brown, McDowell and Fryer[97] assure us that atomic-radiation lesions may increase as work in turning mass into energy increases. The lesion produced by atomic radiation is not a new one entirely, but the time element of the development is faster owing to excessive exposure in a short space of time. The burns probably occur from both beta and gamma radiation. Conservative therapy, especially about the hands, avoiding early amputation, is indicated because hopeless looking fingers may be spared.

Ivy[98] reports on the repair of full-thickness cheek defects following irradiation necrosis. Cronin[99] pleas for a greater recognition of the potential dangers of radiation therapy in both benign and malignant conditions. Any measure short of extirpation of the lesion can be only palliative. Freeman[100] advises using fluorescein as an agent for determining the extent of deep radionecrotic lesions.

HAND.

Brown and McDowell[2] have found that the most common form of syndactylism is symmetrical webbing in two normal hands between the third and fourth fingers throughout their length. The operation is best delayed on these until the patient is three years old. The fingers are divided, being careful at the proximal end of the new fissure to avoid injury to any of the proper vessels or nerves. The resulting raw surface is covered with a single full-thickness skin graft. It is best to avoid operating on both sides of any one finger at one time. Sodenberg[101] reports a case of syndactylism associated with absence of the pectoral muscle.

A method for restoring an effective grasping function to a hand crippled by the loss of all five digits is presented by Cannon, Graham and Brown.[102] Elongation of the thumb and clefting of the hand are accomplished without disturbing normal sensation in the hand. The presence of movement at the articulation of the first metacarpal with the greater multangular is essential. The thumb is elongated if the bony stump is shorter than that of the index finger. This is accomplished through a dorsal incision, and the head of the second metacarpal is transplanted to the end of the first. Kirschner-wire fixation is used. The base of the second metacarpal is left to prevent collapse of the metacarpal arch. The cleft is made using a dorsal rectangular flap across the base of the cleft and thick split skin grafts to the sides.

The restoration of pinch function to the crippled hand by reconstruction of an opposition digit was the most common need found by Baxter, *et al.*[103] Reconstruction of the thumb can be done in many ways. They prefer to lengthen the thumb with a tube pedicle and bone graft in four operations.

Evans[104] discusses major injuries of the hand and emphasizes the importance of immediate and complete skin coverage to prevent infection, fibrosis and limitation of function. Hyroop[105] has transferred a metacarpal with or without its digit in 34 cases. This has proved an effective and efficient method of repair of certain types of crippled hands.

In the normal hand, notes Young,[106] the skin of the thumb-index web, thenar eminence and midpalm is a functioning unit which allows the thumb to move almost as a universal joint. Scar contracture of this region can be relieved by one of four methods: *1.* Z-plasty, *2.* local flaps, *3.* free skin grafts, or *4.* thinned pedicle-flap transfers.

Braithwaite and Watson[107] advise the early grafting of burns of the hand. Early excision of full thickness of damaged skin down to and including the deep fascia should be performed and followed by skin grafting. Braithwaite, *et al.*,[108] discuss the anatomy and function of the extensor-tendon complex of the hand.

Bruner[109] recommends the use of a dorsal flap to cover the palmar defect after excision of skin and fascia for an advanced Dupuytren's contracture. Flynn[110] discusses flexor-tendon grafts to the hand. Patton and Strain[111] use a molded acrylic splint for a palm and finger graft inserted to correct a burn contracture. The split was used from the twenty-fifth to the ninetieth postoperative day.

NEOPLASMS.

Skin—New[112] believes that cancer of the face does not receive as efficient therapy as one would expect from the site of the lesion and the facility with which a diagnosis can be made. The biopsy should include the entire cancer if possible.

Kraissl and Conway[113] show that Langer's lines are not the most suitable for planning the direction of incisions on the face. The normal wrinkle lines are at right angles to the action of the muscles of expression and afford the best guides to incisions on the face.

Evidence from 40 cases of malignant melanoma treated by surgical excision of regional lymph nodes by McCune[114] shows the value of early surgery. The general principles for treatment of the malignant disease of the face and scalp laid down by Fitz Gibbon and Bodenham[115] are: *1.* wide excision with knife and not diathermy, *2.* removal of regional lymph nodes if palpable, and *3.* immediate coverage with free skin grafts

or large scalp flaps. Bodenham[116] reports a case of a turban tumor treated by excision and immediate skin grafting. Glover and Kiehn[117] point out that Marjolin's ulcers are always preventable by appropriate transplantation of skin for closure of open wounds and by replacement of dense scars before they break down.

Head and Neck—Maroon and Kennedy[118] have reviewed 119 cases of carcinoma of the lower lip treated surgically on the tumor division of the New York Post-Graduate Hospital since 1938. Neck dissections of various magnitudes were done in 95 cases. There was one operative death. Nodes were found positive for malignancy in 18 of the 95 cases. In light of the extremely low mortality of neck dissections, the uniformly good results obtained in available follow-up when nodes removed were found to be negative, and the relatively poor results obtained once nodes are involved, it would seem that prophylactic neck dissection in cases of carcinoma of the lip is strongly indicated.

From a study of 774 cases of sqaumous-cell carcinoma of the lower lip, Judd and Beahrs[119] conclude that patients with Grade II, III or IV lesions should have neck dissections regardless of palpable nodes.

Cade[120] discusses malignancies of the mouth which account for 3 per cent of all cancer deaths in England and Wales. In cancer of the tongue a five-year survival of 27 per cent in 365 total cases was obtained. The primary was treated with radium needles if in the anterior tongue and with teleradium if in the posterior tongue. Neck dissection done only when primary appeared to be controlled. Buccal-mucosa cancer was treated with radium needles with a five-year survival of 61 per cent. A five-year survival of 16 per cent was obtained in carcinoma of the alveolar ridge.

Simmons and Ariel[121] present the pathology and clinical features of 150 patients with nasopharyngeal carcinoma. Of the lesions, 34.7 per cent were epidermoid carcinoma and 30.7 per cent were transitional-cell carcinoma. Intracranial extension occurs via foramen lacerum. Cranial-nerve involvement occurs

in 36 per cent of the patients, and 86 per cent of patients develop cervical-node metastases. The presence of a neck mass was the initial symptom in 50 per cent of the cases. A five-year survival of 9.8 per cent is reported.

Capps[122] reports a 37.8 per cent five-year-cure rate for malignant disease of the paranasal sinuses. About 80 per cent of these tumors occur in the antrum. Cordray[123] reports on 61 cases of mixed tumors of the head and neck. Seven of these were malignant. Recurrence in four cases of benign mixed tumor followed surgical excision.

Parotid Gland—Wheelock and Madden[124] present 13 uncommon tumors of the salivary glands. State[125] reports on the treatment of mixed tumors of the parotid gland by subtotal and total parotidectomy. Mohs[126] uses a chemosurgical technique in the treatment of parotid tumors. He reports 13 patients with carcinoma of the parotid with a 60 per cent five-year cure.

Mandible—Thoma[127,128] classifies tumors of the jaws as: *1.* odontogenic, *2.* osteogenic, *3.* miscellaneous, and *4.* metastatic. The tissues of the tooth are derived from two germ layers; thus, odontogenic tumors may be ectodermal in origin, mesenchymal or of mixed origin. Tumors may be made up of tissue derived from osteogenic mesenchymal cells.

Slaughter, *et al.*,[129] report on partial, segmental or hemiresection of the mandible for neoplastic disease. Surgery in 15 patients was for primary tumors of the jaw. In 49 cases it was for tumors of contiguous tissue to or involving the mandible. The technique of combined neck and jaw resection is given. Conley and Pack[130] also discuss the surgical treatment of malignant tumors of the inferior alveolar ridge and mandible. Catlin[131] reports on a massive adamantinoma of the mandible treated by complete resection of the mandible and upper-neck dissection.

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THE GRADUATE SCHOOL OF MEDICINE OF THE UNIVERSITY OF FLORIDA ANNOUNCES MID-WINTER SEMINAR IN OPHTHALMOLOGY AND OTOLARYNGOLOGY.

The Fifth Annual University of Florida Mid-Winter Seminar will be held at the Sans Souci Hotel, Miama Beach, Fla., beginning on Jan. 15 and continuing through Jan. 20, 1951. Lectures on Otolaryngology, Jan. 15, 16; on Ophthalmology, Jan. 18, 19, 20. On Jan. 17, a program will be presented by the Southern Section of the American Laryngological, Rhinological and Otological Society, Inc. The combined meeting of the Mid-Winter Convention of the Florida Society of Ophthalmology and Otolaryngology and the Seminar will be held Wednesday evening, Jan. 17, 1951.

The complete schedule of lectures and reservation blanks for the course will be mailed to all E., E., N. and T. specialists early in September. For those who desire to register immediately, a check for $10.00 payable to "The University of Florida Mid-Winter Seminar" must accompany your application for registration. This deposit is not returnable. The balance of the course fee is payable at the registration desk at the Seminar headquarters—on your arrival.

The Division of Ophthalmology is under the direction of Shaler Richardson, M.D., Jacksonville; Nelson M. Black, Miami; Charles Boyd, M.D., Jacksonville; Bascom Palmer, M. D., Miami.

The Division of Otolaryngology is under the direction of H. Marshall Taylor, M.D., Jacksonville; Walter T. Hotchkiss, M.D., Miami Beach.

Application for registration should be sent to Dr. Walter T. Hotchkiss, 541 Lincoln Road, Miami Beach 39, Fla.

Registration fee for the entire course is $40.00. A group of America's outstanding eye, ear, nose and throat specialists will participate in the program.

This 1951 session will be held at the beautiful Sans Souci Hotel on the ocean front. Here you can combine a wonderful

Winter vacation and a highly instructive schedule of lectures. The hotel is equipped with pool and cabanas, excellent dining room and coffee shop and offers every modern facility of an outstanding hotel in America's Wonderful Winter Playground.

Special rates of $18.00 (double). For those seeking more moderate accommodations, the Scott-Bryan directly opposite the Sans Souci offers rooms for $12.00 single or $14.00 double. The El Morocco, also opposite, offers excellent accommodations for $10.00 single or $12.00 double. Ocean front facilities at the Sans Souci are available to guests of the Scott-Bryan and El Morocco Hotels. Make your reservation as early as possible, directly with the Sans Souci Hotel, which has charge of all reservations.

BOOK REVIEWS.

Your Deaf Child. A Guide for Parents. By Herbert R. Myklebust, Ed.D., Professor of Audiology, Northwestern University, Evanston, Ill., with foreword by Hallowell Davis, M.D., Director of Research, Central Institute for the Deaf, St. Louis, Mo. 132 pages and 17 illustrations. Springfield, Ill.: Charles C. Thomas, 301-327 East Lawrence Avenue, 1950. Price $2.50.

This is an excellent book written entirely for laymen and particularly for parents of deaf children. It contains a fund of information in a manner easily understood and in good, clear English. The chapters on the parent's attitude toward the child and the training of the deaf child in its younger years are particularly valuable. Otologists would be well advised to read this book for their own information and to advise the parents of their young deaf patients to get the book for a handy reference at home.

A very valuable addition is Chapter Eight in which Dr. Myklebust lists organizations which are interested in the deaf and hard-of-hearing children and books and periodicals which might help the parents of these children and also a list of the schools for the deaf and hard of hearing in Canada and the United States. This chapter alone would be worthwhile having in an otologist's office.

All in all, this is an excellent book which one can heartily recommend to otologists and to the parents of deaf children.

Bronchoesophagology. By Chevalier Jackson, M.D., Sc.D., LL.D., F.A.C.S., Honorary Professor of Bronchoesophagology and Laryngeal Surgery, Temple University, Philadelphia; and Chevalier L. Jackson, M.D., Sc.D., F.A.C.S., Professor of Bronchoesophagology and Laryngeal Surgery, Temple University, Philadelphia. 366 pages with index and 261 illustrations. Philadelphia: W. B. Saunders Co., 1950. Price $12.50.

This book is, in effect, a new edition of the Jacksons' previous books on bronchoesophagology. All the material is brought up to date, it is profusely and beautifully illustrated and is a book, I believe, essential for all students of ear, nose and throat.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION.

As of April 1, 1950.

Aurex Model F and Model H.
Manufacturer: Aurex Corp., 1117 N. Franklin St., Chicago, Ill.

Beltone Mono-Pac; Beltone Harmony Mono-Pac; Beltone Symphonette; Beltone Mono-Pac Model M.
Manufacturer: Beltone Hearing Aid Co., 1450 W. 19th St., Chicago, Ill.

Cleartone Model 500; Cleartone Regency Model.
Manufacturer: American Sound Products, Inc., 2454 S. Michigan Ave., Chicago 16, Ill.

Dysonic Model 1.
Manufacturer: Dynamic Hearing Aids, 43 Exchange Pl., New York 5, N. Y.

Electroear Model C.
Manufacturer: American Earphone Co., Inc., 10 East 43rd St., New York 17, N. Y.

Gem Hearing Aid Model V-35; Gem Model V-60.
Manufacturer: Gem Ear Phone Co., Inc., 50 W. 29th St., New York 1, N. Y.

Maico Atomeer; Maico UE-Atomeer; Maico Quiet Ear Models G and H.
Manufacturer: Maico Co., Inc., North Third St., Minneapolis, Minn.

Mears Aurophone Model 200; 1947—Mears Aurophone Model 98.
Manufacturer: Mears Radio Hearing Device Corp., 1 W. 34th St., New York, N. Y.

Micronic Model 101 (Magnetic Receiver); Micronic Model 303. (See Silver Micronic.)
Manufacturer: Micronic Co., 727 Atlantic Ave., Boston 11, Mass.

Microtone T-3 Audiomatic; Microtone T-4 Audiomatic; Microtone T-5 Audiomatic; Microtone Classic Model T9; Microtone Model 45.

Manufacturer: Microtone Co., 4602 Nicollet Ave., Minneapolis 9, Minn.

National Cub Model C; National Standard Model T; National Star Model S; National Ultrathin Model 504; National Vanity Model 506.

Manufacturer: National Hearing Aid Laboratories, 815 S. Hill St., Los Angeles 14, Calif.

Otarion Model E-1; Otarion Model E-1S; Otarion Model E-2; tarion Model E-4; Otarion Models F-1 and F-2.

Manufacturer: Otarion Hearing Aids, 159 N. Dearborn St., Chicago, Ill.

Paravox Models VH and VL (Standard); Paravox Model XT (Xtra-Thin); Paravox Model XTS (Xtra-Thin); Paravox Model Y (YC and YC-7) (Veri-Small).

Manufacturer: Paravox, Inc., 2056 E. 4th St., Cleveland, Ohio.

Radioear Permo-Magnetic Multipower; Radioear Permo-Magnetic Uniphone; Radio Ear All Magnetic Model 55; Radioear Model 62 Starlet.

Manufacturer: E. A. Myers & Sons, 306 Beverly Rd., Mt. Lebanon, Pittsburgh, Pa.

Silver Micronic; Silver Micronic (Magnetic and Crystal) Models 202M and 202C. (See Micronic.)

Manufacturer: Micronic Corp., 101 Tremont St., Boston 8, Mass.

(See Micronic.)

Silvertone Model 103BM; Model M-35; Model P-15.

Manufacturer: National Hearing Aid Laboratories, 815 S. Hill St., Los Angeles 14, Calif.

Distributor: Sears-Roebuck & Co., Chicago, Ill.

Solo-Pak Model 99.

Manufacturer: Solo-Pak Electronics Corp., Linden St., Reading, Mass.

Sonotone Model 600; Sonotone Model 700; Sonotone Model 900; Sonotone Models 910 and 920; Sonotone Model 925.

Manufacturer: Sonotone Corp., Elmsford, N. Y.

Superfonic Hearing Aid.

Manufacturer: American Sound Products, Inc., 2454 S. Michigan Ave., Chicago, Ill.

Televox Model E.
Manufacturer: Televox Mfg. Co., 117 S. Broad St., Philadelphia 7, Pa.

Telex Model 22; Telex Model 97; Telex Model 99; Telex Model 200; Telex Model 1700.
Manufacturer: Telex, Inc., Minneapolis 1, Minn.

Tonemaster Model Royal.
Manufacturer: Tonemasters, Inc., 1627 Pacific Ave., Dallas 1, Tex.

Trimm Vacuum Tube No. 300.
Manufacturer: Trimm, Inc., 400 W. Lake St., Libertyville, Ill.

Unex Model "A"; Unex Midget Model 95; Unex Midget Model 110.
Manufacturer: Nichols & Clark, Hathorne, Mass.

Vacolite Model J.
Manufacturer: Vacolite Co., 3003 N. Henderson St., Dallas 6, Tex.

Western Electric Model 63; Western Electric Model 64; Western Electric Models 65 and 66.
Manufacturer: Western Electric Co., Inc., 120 Broadway, New York 5, N. Y.

Zenith Model 75; Zenith Miniature 75.
Manufacturer: Zenith Radio Corp., 6001 Dickens Ave., Chicago, Ill.

All of the accepted hearing devices employ vacuum tubes.

Accepted Hearing Aids more than five years old have been omitted from this list for brevity.

TABLE HEARING AIDS.

Aurex (Semi-Portable)—*Jour. A. M. A.*, 109:585 (Aug. 21), 1937.
Manufacturer: Aurex Corp., 1117 N. Franklin St., Chicago (10), Ill.

Precision Table Hearing Aid—*Jour. A. M. A.*, 139:785-786 (Mar. 19), 1949.
Manufacturer: Precision Electronics Co., 850 West Oakdale Ave., Chicago 14, Ill.

Sonotone Professional Table Set Model 50—*Jour. A. M. A.*, 141:658 (Nov. 15), 1949.
Manufacturer: Sonotone Corp., Elmsford, N. Y.

All of the Accepted hearing devices employ vacuum tubes.

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Western Section: San Francisco, Calif., Jan. 27-28, 1951.

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Richmond, Va., May 1-4, 1951.

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